DIET
AND
HEART DISEASE

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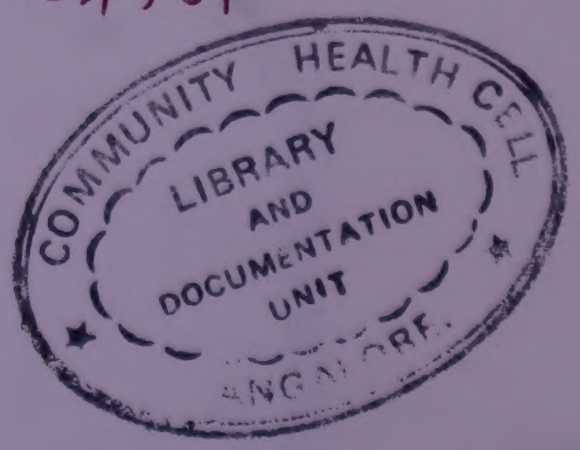

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FOREWORD

Cardiovascular disease can no longer be considered a problem of only affluent countries. With rapid industrialization, socioeconomic development and increase in life expectancy, the stage is now set for chronic diseases in India. In recent years, there has been a significant change in lifestyle and dietary patterns with growing affluence. There is enough evidence linking dietary habits to cardiovascular diseases. New research findings in this area indicate the potential value of diets in prevention of such disorders. It is probably the right time to take a fresh look at the diets consumed by our population and formulate appropriate dietary guidelines to prevent and control these diseases. This book is an attempt in that direction.

The authors of the book are senior scientists of National Institute of Nutrition (NIN), with considerable expertise in the field of nutritional sciences. Dr. Ghafoorunissa, Ph.D. in Biochemistry, has made valuable contributions in the area of lipids in health and disease. Dr. Kamala Krishnaswamy, M.D. Internal Medicine, is known for her long time involvement and significant contributions in the area of chronic diseases.

The book reflects the research work done at NIN and its translation into practical dietary guidelines for managing coronary artery disease and hypertension. The authors have examined the important relationships between diet and the cardiovascular diseases in a comprehensive manner and suggested suitable diets for reducing the risk of such disorders. They also advocate changes in lifestyles that are necessary for healthy and productive life. I am sure this information will be useful to physicians and dietitians as well as the patients.

Dr. Vinodini Reddy
Director

PREFACE

Cardiovascular disease, cancer and diabetes appear to be the most common causes of disability and death in many parts of the world. Scientific evidences today support the concept that these diseases have their roots in our daily diets. In recent years, researches at National Institute of Nutrition (NIN) have focussed attention on dietary aspects of the above diseases.

Heart disease and stroke evoke fear in everyone of us as they catch you napping all of a sudden. They cause physical/mental trauma or premature sudden death. Recent findings suggest that these diseases are steadily increasing in India and may become a major public health problem by the turn of the century. Though we have the best medical and surgical treatments, it is undoubtedly ideal to prevent these diseases. This is particularly important because of the exorbitant cost of treatment.

This book provides an up-to-date information on diet-related aspects of heart disease in adults, examines the subject in the Indian context based on the researches done at NIN and provides dietary guidelines for its prevention. The principles underlying the dietary guidelines are based on Indian studies and some aspects are adapted from Western data. We have described in simple language the function of the heart and the disease process responsible for heart attacks. This is followed by risk factors and the scientific rationale behind each of the dietary guidelines. Apart from diet, other lifestyle factors have also been included to give a holistic approach to the topic.

The book caters to a mixed readership. While some of the sections are undoubtedly technical, the research findings have also been distilled into simple and practical messages. It will be useful to doctors, dietitians, students as well as the general public. It is our earnest hope that this humble effort of ours will motivate the public to preserve our healthy traditional lifestyles and refrain from choosing unhealthy easy options that the modern world offers.

We are grateful to Dr. Vinodini Reddy, Director, National Institute of Nutrition, Hyderabad, for her interest and constant encouragement. We are pleased to thank Dr. C. Gopalan, President, Nutrition Foundation of India, New Delhi, Dr. G. V. Satyavati, Director-General, Indian Council of Medical Research, New Delhi, Dr. S. Padmavati, President, All India Heart Foundation, New Delhi, Dr. P. Satyanarayana Rao, Emeritus Professor of Cardiology and Dean, Faculty of Medicine, Osmania University, Hyderabad, and Dr. K. T. Achaya, President, Nutrition Society of India, for reviewing the book and giving valuable suggestions. We thank all our colleagues for their helpful comments.

Ghafoorunissa
and
Kamala Krishnaswamy

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SELF HELP

No one knows you better than yourself

No one can eat for you

No one can lose weight for you

No one can think for you

No one can stop bad habits for you

No one can develop good habits for you

No one can take medication for you

No one but YOU can change yourself

SELF HELP IS THE BEST POSSIBLE ROAD TO HEALTH.
NO ONE EXCEPT YOU, IS MORE INTERESTED IN YOUR HEALTH.

1. INTRODUCTION

Proper diet is the key to good health and vigour. Diet and nutrition are synonymous with health. It provides the necessary nutrients which give energy, promote growth, and sustain the metabolic functions and repair processes that are essential for life. The *preventive role of corrective nutrition* is an ever-evolving process. Inadequate and improper diets are not only responsible for undernutrition, but also contribute to several chronic degenerative diseases such as cardiovascular diseases, diabetes and cancer.

Everyone wishes to remain youthful even in old age. *Sensible and healthy food habits* right from childhood coupled with *good lifestyles* can, not only delay ageing and increase the *life span,* but also add to the *quality of life. "HEALTH FOR ALL BY 2000 A.D."* and *"ALL FOR HEALTH"* should encompass diseases due to inadequate as well as faulty diets. As we move up the ladder of economic prosperity, diet-associated chronic diseases begin to assume significance. A changing demographic profile and technological progress can lead to many health problems. Coupled with sedentary lifestyles, imbalanced diets can contribute to chronic degenerative diseases.

Cardiovascular diseases have no geographic and racial boundaries. They occur throughout the world, in all races and in all strata of society, though variations between sexes, ages and socio-economic status do exist. They are life threatening and are responsible for the majority of deaths in many countries. Since they are often fatal, biomedical research all over the world is directed towards prevention of heart diseases at an early stage. Attempts are being made to define living habits that might be associated with an increased risk (Page 10).

Combating heart disease is one of the challenging problems of medical science. Treatment, though advanced, is only one component of the care of heart patients. It is expensive and often beyond the reach of the common man in developing countries. It would be to our advantage to prevent the disease through several available approaches.

CONQUER HEART DISEASE THROUGH MODIFICATIONS IN YOUR LIFESTYLE

2. PREVENTION IS BETTER THAN CURE

The adage "Prevention is better than cure" is particularly appropriate for chronic diseases since the cost of treatment far outweighs the cost of disease prevention. The public in general and administrators and professionals in particular are therefore interested in disease prevention. *Chronic diseases are multifactorial* in origin and therefore require a complex mix of interventions. A wide selection of foods from each of the different food groups to ensure a balanced diet, and avoidance of over-indulgence in foods can maintain health and *prevent diseases* like heart diseases, cerebrovascular diseases (strokes), diabetes, obesity and cancer. In this booklet, an effort is made to highlight the importance of diet and related aspects of heart diseases. Current scientific knowledge has been translated into effective and applicable suggestions. Given a *motivated public,* it is not difficult to achieve a productive life *free* from *chronic ailments*.

"PREVENTION HAS BECOME THE TRUE MEDICAL MIRACLE".
- Otis R. Bowen

3. THE HEART, ITS STRUCTURE AND FUNCTION

To understand the why, when and how diseases affect the heart and its functioning, it is necessary to know something about the heart, its structure and function (Fig.1).

The heart is placed behind the breast bone and within the ribs (thoracic cage) with the lungs on either side. It is a hollow muscular organ made up of smooth

HEART AND BLOOD CIRCULATION

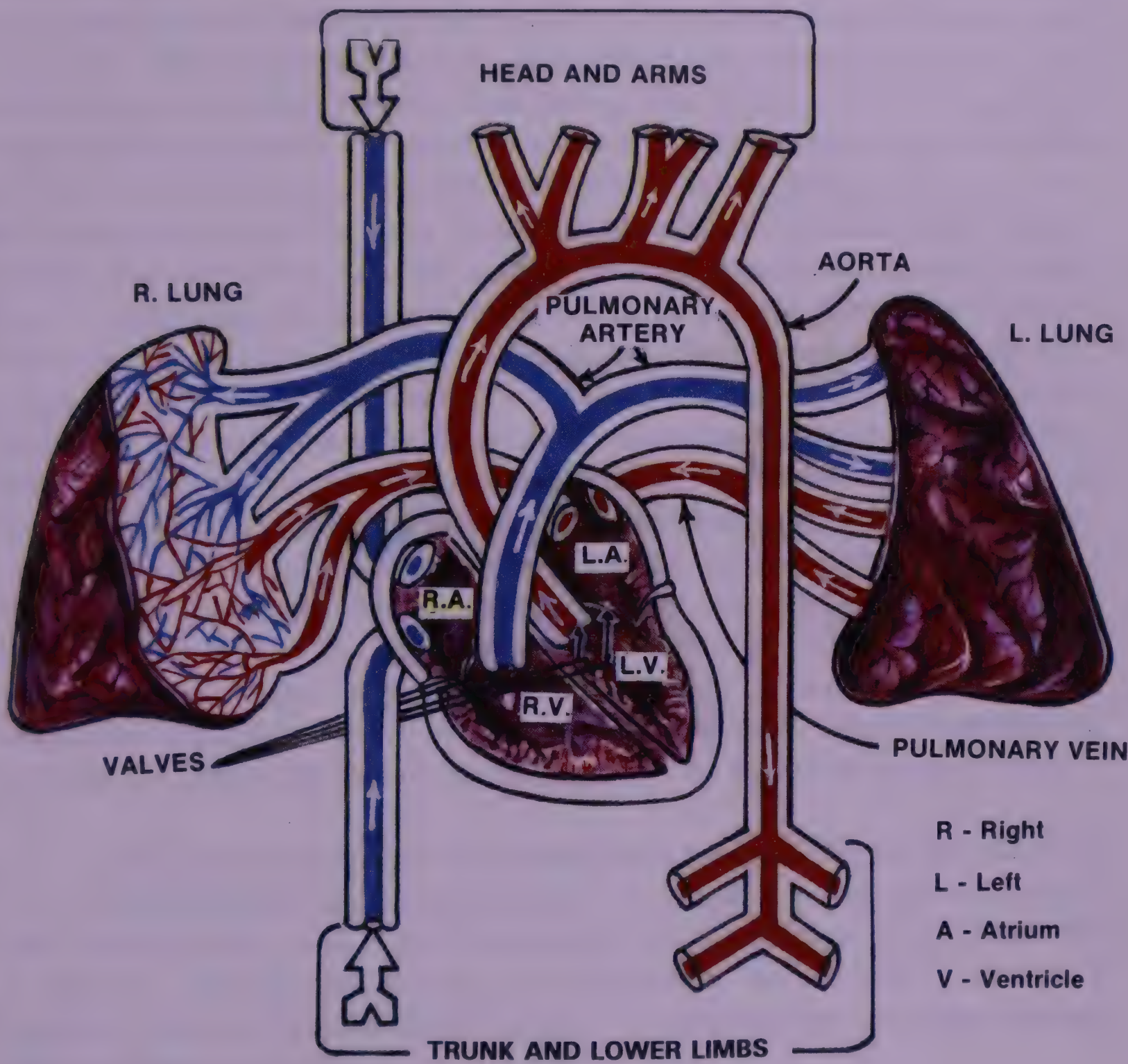
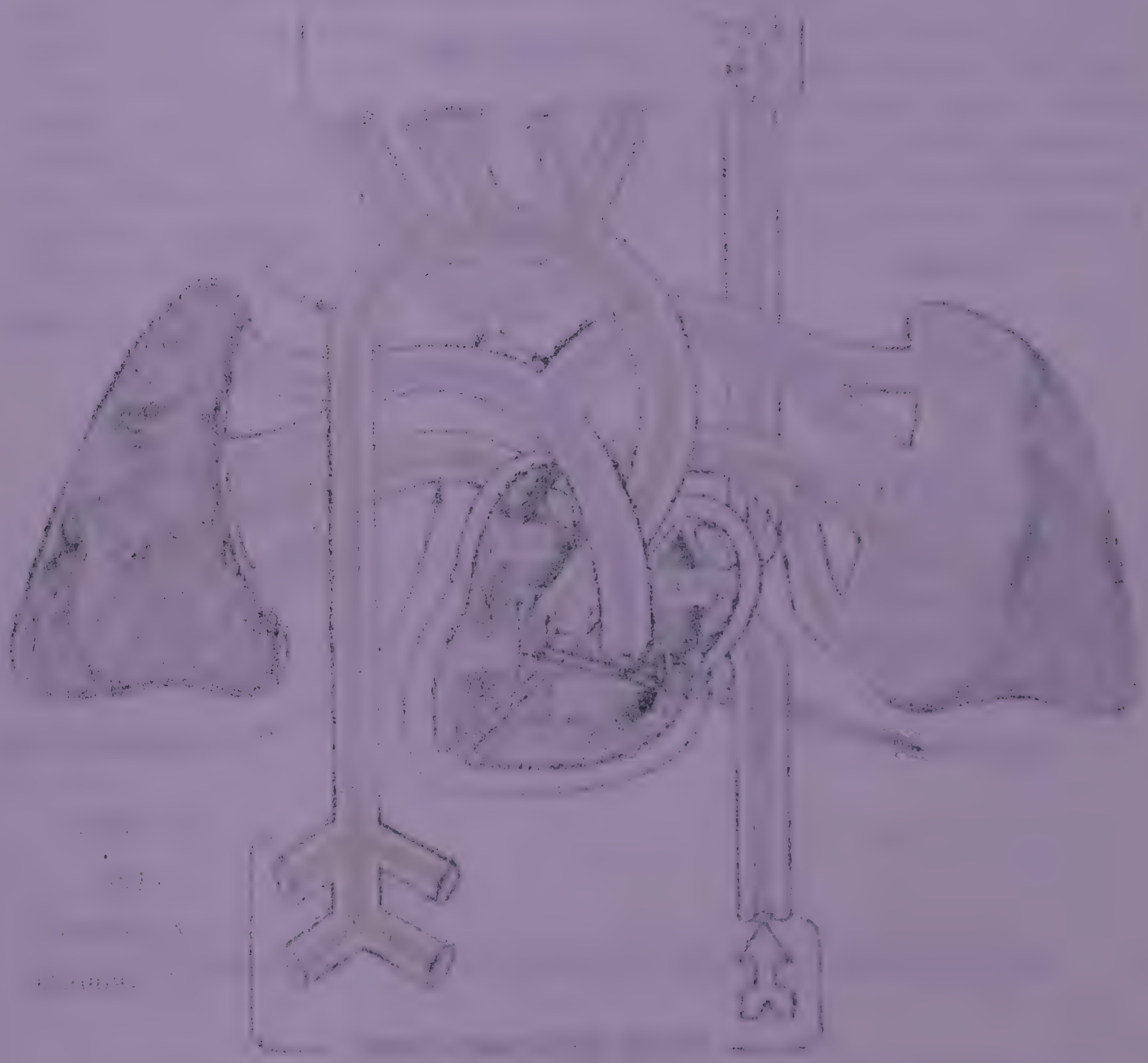


Figure 1



muscles (myocardium). It is enclosed in a sac known as the pericardium (outside layer), and shaped like an egg, is about the size of a person's clenched fist and weighs around 300 g. in a man and 250 g. in a woman.

The heart has *four chambers,* two atria (upper) and two ventricles (lower). Valves connect the upper and lower chambers. A valve is like a one-way door that allows blood to flow only in one direction. The right and left sides of the heart are totally separated by a muscular wall and there is no communication between them. The *right side* of the heart receives *deoxygenated* (impure) blood collected from different parts of the body through small and big veins which enters the lungs. In the lungs blood is oxygenated and carbon dioxide and metabolic waste are removed. The *left side* of the heart gets *oxygenated* (pure) blood from the lungs and supplies it to the entire body through the major blood vessel (aorta) and its innumerable branches (arteries and capillaries). The left ventricle generates considerably greater pressure than the right ventricle, to enable the blood to be pumped throughout the body. Hence the left ventricle is thicker and more muscular; it is the largest of the four chambers and needs considerable blood and oxygen supply. Blood carries nourishment and oxygen to each and every cell and tissue of the body. Like any other tissue, the heart muscle also needs a good supply of oxygenated blood. This is done through *two major coronary arteries* which are placed as a crown on the heart. They pursue a wavy course to adapt themselves to the beating heart. The coronary arteries branch out (left and right coronary arteries) from the root of the aorta near its origin from the left ventricle. The left coronary artery further gets divided into two main branches near its origin itself. Both the coronary arteries branch off into smaller vessels which are distributed all over the surface of the heart. The left ventricle, the principal and largest chamber of the heart receives the maximum supply of blood.

The *coronary blood* flow in a normal adult averages 200-250 ml/minute (4-5% of cardiac output). In a healthy adult at rest, the heart pumps approximately 5 litres of blood every minute. Each heart beat is the act of blood being pumped out of the heart. For efficient pumping, it is necessary for the heart to beat at a reasonable rate of 60-90 beats/minute which is achieved through controlled electrical impulses (conduction system).

The normal pressure of blood against the walls of the arteries is called *blood pressure*. The normal blood pressure, when the heart contracts, is called systolic pressure and is between 100-140 mm of mercury. When the heart relaxes, the pressure is known as diastolic pressure and lies between 70-90 mm of mercury.

Blood pressure is commonly expressed as systolic/diastolic, for example 100/70, or 140/90 mm of mercury. In its strenuous daily routine the heart pauses for rest for a split second between beats. The heart and the blood vessels together constitute the cardiovascular system.

THE HEART IS A VITAL ORGAN WHICH ONE SHOULD LOOK AFTER WELL

4. CARDIOVASCULAR DISEASES

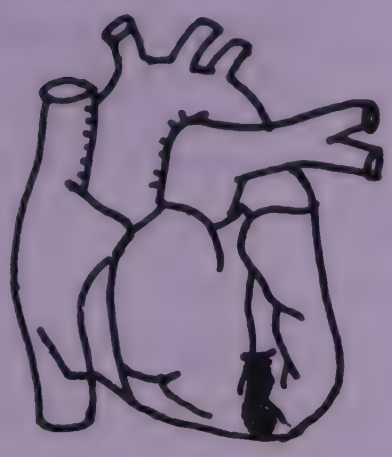
The function of the heart is to supply blood to the entire body as every cell or tissue in the body needs oxygen. The heart in turn as described earlier gets its nourishment through the coronary arteries. Therefore, it is necessary that the coronary arteries, the heart muscles and the blood supply through several blood vessels is maintained properly throughout the entire body. However, as *age advances* or because of certain *lifestyle factors* which injure the blood vessels as well as the coronary arteries, one tends to get diseases associated with cardiovascular system.

The term cardiovascular disease includes several diseases such as coronary artery disease, stroke, hypertension, peripheral artery disease, rheumatic heart disease and congenital heart disease. Focus of our attention is on coronary artery disease and related disorders. These diseases are commonly associated with a high rate of hospitalization and death.

Coronary Artery Disease is precipitated by obstruction of coronary arteries which nourish the heart muscle. It can manifest as angina and heart attacks.

Angina : The narrowing of the coronary arteries results in insufficient blood supply (ischaemia) causing severe pain across the chest. This kind of pain is called angina and is the cry of the hungry heart. The pain subsides after a few minutes, but this is the first sign of trouble.

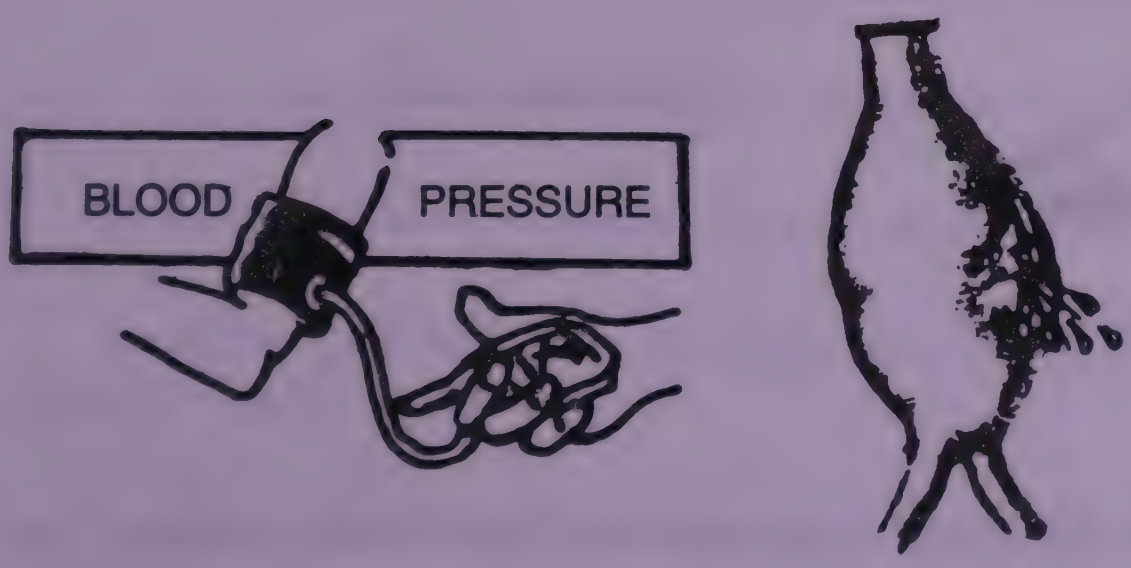
Heart Attack : This happens when there is a sudden block in blood flow in one or more of the coronary arteries and this cuts off blood supply to a part of the heart muscle, causing permanent damage. If the block is severe, the heart can stop beating (cardiac arrest).



Severe pain in chest, abnormal beats, sudden death

Figure 2.1

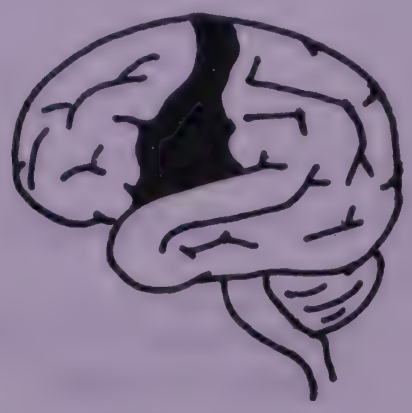
Hypertension : Hypertension is a term used to describe persistent elevation of blood pressure; it impairs the pumping function of the heart and if untreated, damages the heart, brain and kidneys.



Heart attack
Stroke
Blood vessel rupture

Figure 2.2

Stroke : This results from a block in the vessels supplying blood to the brain or when an artery ruptures (cerebral haemorrhage). A stroke occurs more often in patients with high blood pressure.



Paralysis
Speech and vision defects
Mental deterioration
Memory lapses
Fainting spells

Figure 2.3

Peripheral artery disease occurs when blood vessels supplying blood to the limbs are blocked. Reduced blood supply may result in irreversible damage and death of tissue (gangrene). It often occurs in blood vessels of the legs and is common in diabetes.

Intermittent pain

Figure 2.4

The processes commonly responsible for the above diseases are atherosclerosis and thrombosis.

A DISEASE KNOWN IS ONE HALF CURED

5. ATHEROSCLEROSIS AND THROMBOSIS

WHAT IS ATHEROSCLEROSIS ?

Atherosclerosis is a process by which arteries (blood vessels) are narrowed due to deposition of a gruel like material made up of lipids and blood cells (athero: gruel; sclerosis: hardening). It is a vessel clogging disorder which is dormant for quite sometime and manifests as age advances. It occurs in both large and medium sized arteries - aorta, coronary arteries, arteries of the brain, lower limbs and kidneys. The wall of the arteries become brittle and roughened in atherosclerosis, narrowing the channel through which blood flows. The blood cells easily adhere to the roughened walls and form blood clots (thrombus). The clot reduces the supply of blood and thereby the oxygen to tissues/organs (ischaemia). To understand the process of atherosclerosis, it is important to know the structure of the arteries. Arteries consist of three layers (Fig.3).

1. The inner layer *(Intima)* consists of a thin layer of cells (endothelial).

2. The middle layer *(Media)* consists of smooth muscle cells and is bound by two layers on either side.

3. The outer layer *(Adventitia)* consists of collagen and elastic fibres.

The lumen of the arteries become narrow as age advances.

Atherosclerosis is an accelerated process of ageing.

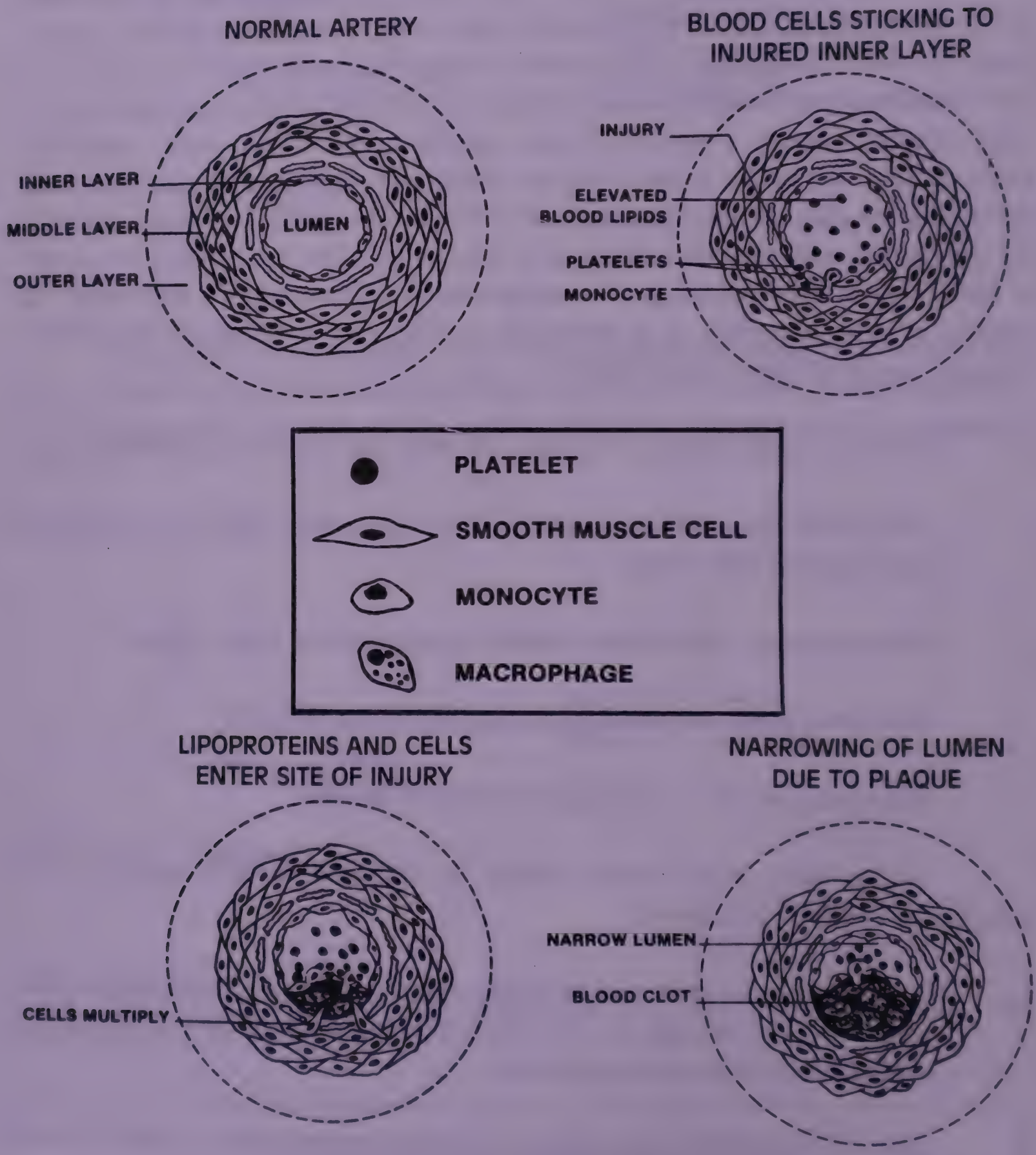
All the three layers of the arteries are damaged in atherosclerosis. The progress of events is as follows :

1. *Damage* to inner layer can be either due to biological (lipids/lipoproteins, peroxides, free radicals etc.) or physical (turbulent blood flow and abnormal contractions) injury or due to both.

2. *Cells* in blood (platelets, monocytes, macrophages) *stick* (clump) to the damaged inner surface.

Figure 3

ATHEROSCLEROTIC PROCESS



3. *Lipids in blood (Lipoproteins),* enter *focal regions* of injury.

4. Several *chemical substances* released from cells (platelets, monocytes and macrophages) promote contraction of the vessels. They attract more cells around the damaged site thickening the wall further and partially *blocking* the vessels with small blood clots *(microthrombi).*

5. The natural ability of blood clots to get dissolved *(fibrinolysis)* is reduced.

6. Further *damage* occurs to the inner and middle layers.

7. Smooth muscle cells in the middle layer multiply (in response to injury) and the wall becomes thickened and hardened *narrowing* the lumen further. Such narrowing restricts the blood flow through the affected vessel.

8. More lipids are attracted towards the injured surface and accumulate in the wall.

9. The outer layer is also damaged by the formation of excess fibrous (hard) tissue, and becomes more *rough* and *brittle.*

10. The narrowed lumen can get *totally blocked* by a *big thrombus* formed by platelets, red blood cells and other cells sticking together.

11. *Occlusion* (cutting off blood supply) results in *death* of tissues.

12. Clot-formation (thrombosis) can also occur *independent* of changes in the arterial wall (atherosclerosis).

13. These lesions can start even at a young age of 10-15 years and progress as age advances.

APPROPRIATE FOOD CHOICES RIGHT FROM AN EARLY AGE CAN PREVENT, DELAY OR DECREASE THESE LESIONS AND PREVENT PREMATURE DISABILITY AND DEATH.

MAN IS A PRODUCT OF NATURE AND NURTURE

IS IT DESTINY ?

YES

Static and non-modifiable factors

CAN YOU OVERCOME YOUR DESTINY ?

YES

Dynamic and modifiable factors

THE SPOKES OF THE WHEEL WHICH DRIVES YOUR HEART TO YOUR DESTINATION

Figure 4

Atherosclerosis and thrombosis are not due to any single factor but due to several factors and these are called **risk factors**. The longer the risk factor operates, the greater is the risk of developing the disease. The presence of multiple risk factors has an additive effect on risk. The three major risk factors are smoking, high blood pressure and elevated blood lipids.

MODIFY YOUR DYNAMIC RISK PROFILE

6. RISK FACTORS

Today coronary artery disease and hypertension have emerged as the most important cause of premature disability and death all over the world. Genetic susceptibility (heredity) and being a male, makes one more prone to develop these diseases in middle age. It is also known that coronary artery disease is an unavoidable effect of socio-economic development. It is therefore important to concentrate on factors which can reduce the risk of developing heart disease (modifiable risk factors). Results of several large scale studies show that certain strategies based on *dietary modifications,* if implemented, can *decrease* the *morbidity* associated with diseases of heart and blood vessels and bring about a *regression* (decrease) of the pathological (abnormal) process.

The limited information on heart diseases in our country indicates a higher prevalence in the urban population. Further, *Indians* seem to develop the disease at an *earlier age* than people in the West. Even *Asian immigrants* in the West have a *higher* incidence of heart disease and diabetes than the local population. It is therefore, necessary to reduce the prevalence of these disorders by modifying diet related risk factors (Fig.5).

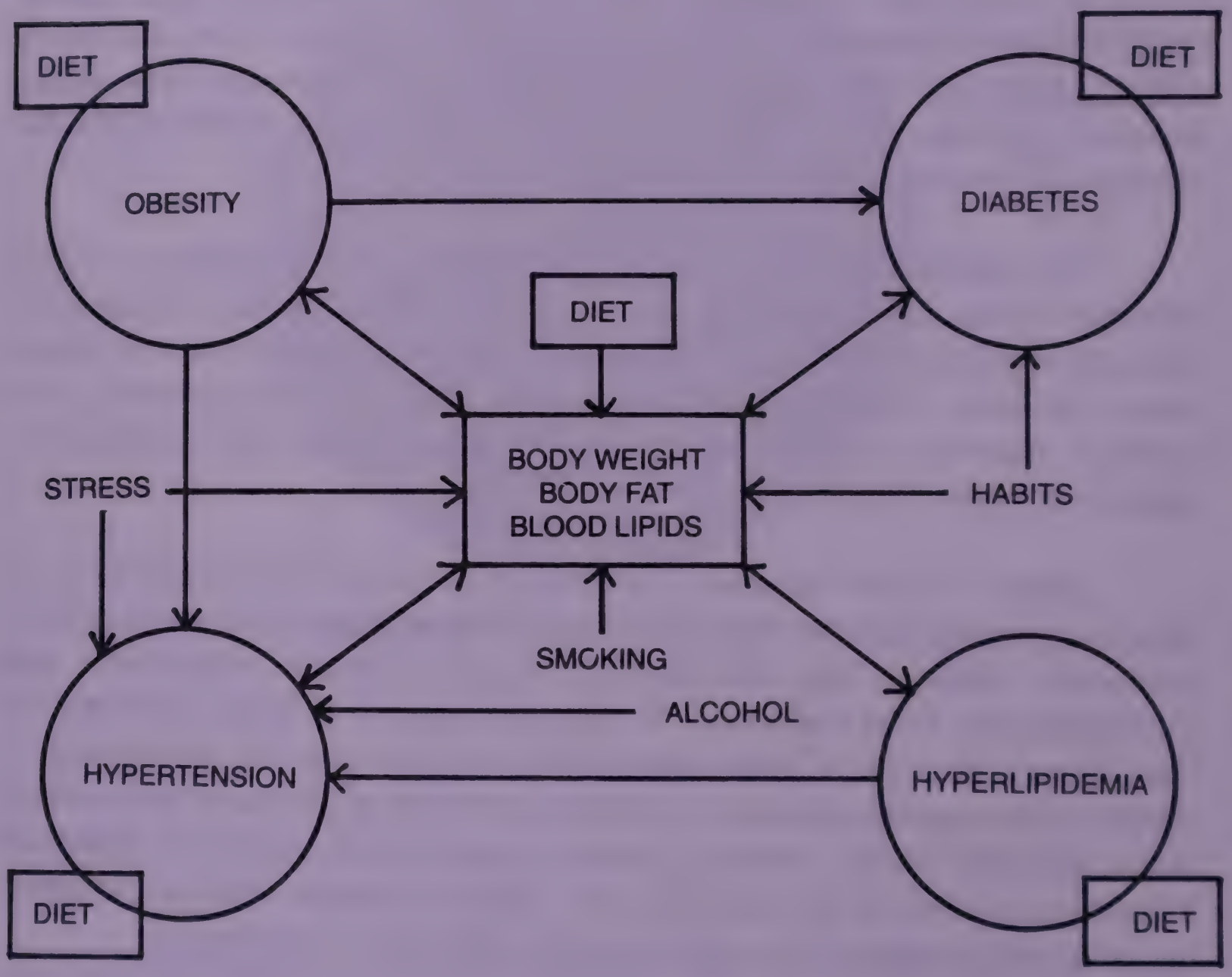
Figure 5 is self explanatory. Diet has an important role in maintaining an ideal body weight, body fat and normal levels of blood lipids. The control of these parameters, helps in the prevention of obesity, diabetes, hypertension and hyperlipidemias. These diseases are in turn, independent diet related risk factors of heart disease. Increase in body weight and blood lipids and the development of atherosclerosis and thrombosis are in fact the end-results of prolonged faulty *dietary habits*. *Improper dietary practices* can also trigger underlying genetic tendencies towards *atherosclerosis* and *thrombosis*. By adopting a *prudent diet* one can reduce the extent and severity of risks which promote injury and fat deposition.

BLOOD LIPIDS

Elevated levels of *blood lipids (cholesterol and triglycerides)* are the *major risk factors* for heart disease (Table 1). Evidences from cholesterol-lowering trials indicate that the incidence of the disease can be reduced within a few years of reduction in blood cholesterol. Diabetes, hypertension and obesity increase blood cholesterol and triglycerides. The major cholesterol fraction, *low density lipoprotein* (LDL), is the most important though not the only causative agent. LDL cholesterol

Figure 5

INTER-RELATIONSHIPS BETWEEN DIET AND OTHER RISK FACTORS



WHATEVER MAY BE THE RISK FACTOR, A PRUDENT DIET CAN PREVENT/ DELAY THE PROGRESSION OF HEART DISEASE

is a strong atherogen since it favours lipid deposition in tissues including blood vessels. High density lipoproteins (HDL) scavenge cholesterol from the blood and tissues and deliver to the liver where it is processed for excretion. HDL cholesterol is therefore called "good" cholesterol. Hence it is desirable to have *higher HDL* and *lower LDL cholesterol in blood*. The triglycerides are also important since they influence lipid deposition and clotting mechanisms. Circulating levels of *LDL and HDL Cholesterol and Triglycerides* are measures of the risk of atherosclerosis.

Table - 1

BLOOD LIPIDS[a] (mg/100 ml Plasma)

	Desirable	Borderline-high	High risk
Total cholesterol	< 200	200-240	> 240
LDL cholesterol	< 130	130-160	> 160
HDL cholesterol	> 50[b]	-	< 35
Triglycerides	< 150	150-500[b]	> 500

< stands for less than, > stands for greater than.

National Cholesterol Education Programme, 1988.

[a] The above figures are for Western Societies.
In Indians, heart attacks occur even at cholesterol levels around 180 mg/100 ml. plasma. (Krishnaswami, *et al.*, 1989).

[b] Arbitrary values.

WHAT YOU EAT IS REFLECTED IN YOUR BLOOD

HYPERTENSION (High Blood Pressure)

Hypertension is *a strong risk factor* for cardiac and blood vessel damage and is associated with high morbidity and mortality (Table 2).

Overweight, particularly fat around the abdomen and excess consumption of alcohol, salt and fat, especially of a saturated nature, are associated with hypertension. In societies where salt intake is about 3 g/day, blood pressure does not increase with age and prevalence of hypertension is negligible. Even in India, in tribal areas where salt intake is about 3 g, hypertension is not observed. Low intakes of potassium, calcium and magnesium also increase the blood pressure. Stress and lack of exercise are contributing factors.

Table - 2

BLOOD PRESSURE IN ADULTS (mm OF Mercury)

Category	Systolic	Diastolic
Normal	< 140	< 90
Mild hypertension	140 - 160	90 - 105
Moderate hypertension	140 - 160	105 - 115
Severe hypertension	> 160	> 115

The 1988 Report of the Joint National Committee, USA, on Detection, Evaluation and Treatment of High Blood Pressure.

OBESITY

Obesity is characterised by an excessive accumulation of body fat through an *increase in the size and number of fat cells*. The higher the body weight, the greater is the risk of not only heart disease, diabetes and hypertension, but also of other diseases like gall stones, osteoarthritis (disease of the joints) and cancer.

Obese individuals have more body fat and higher levels of blood glucose, cholesterol and triglycerides. For every extra kilogram (kg.) of fat, one tends to produce 20 mg more cholesterol per day. Higher *abdominal fat (android)* is known to be a greater risk factor than accumulation of body fat around the hips (gynoid). Android obesity is quite often associated with hypertension, hypertriglyceridemia, hyperinsulinemia and diabetes. Hence it is necessary to maintain ideal body weight. Though there is no strict definition of an ideal body weight, it is usual to compare the weight-for-height ratio with standards based on population surveys. Ideal body weights represent the weights-for-heights of persons with the longest life span, as obtained through insurance data.

The weight-to-height ratio is a simple and widely accepted method which estimates total body mass rather than fat mass. It correlates very well with the amount of body fat. The most commonly used ratio is the Quetlet's index or Body Mass Index (BMI). BMI is body weight in kg divided by the square of height in metres. BMI of 25-30 is an indication of being overweight and BMI above 30 indicates obesity (Table 3 and Figure 6).

The tendency for obesity seems to be *inherited* and *overeating* is clearly an important cause, with *low physical activity* as a contributing factor. Complex behavioural patterns and psychological factors influence the eating pattern. In addition, metabolic errors in energy balance may favour fat deposition. Insulin is an important modifier of energy and fat metabolism, favouring fat deposition. *Higher birth weight* (large babies), *childhood* and *adolescent obesity* make one more *prone* to adult obesity. It is therefore necessary to maintain a desirable body weight by consuming just enough calories to be in *energy balance* (intake = output). *Body weights must therefore be checked and monitored periodically.*

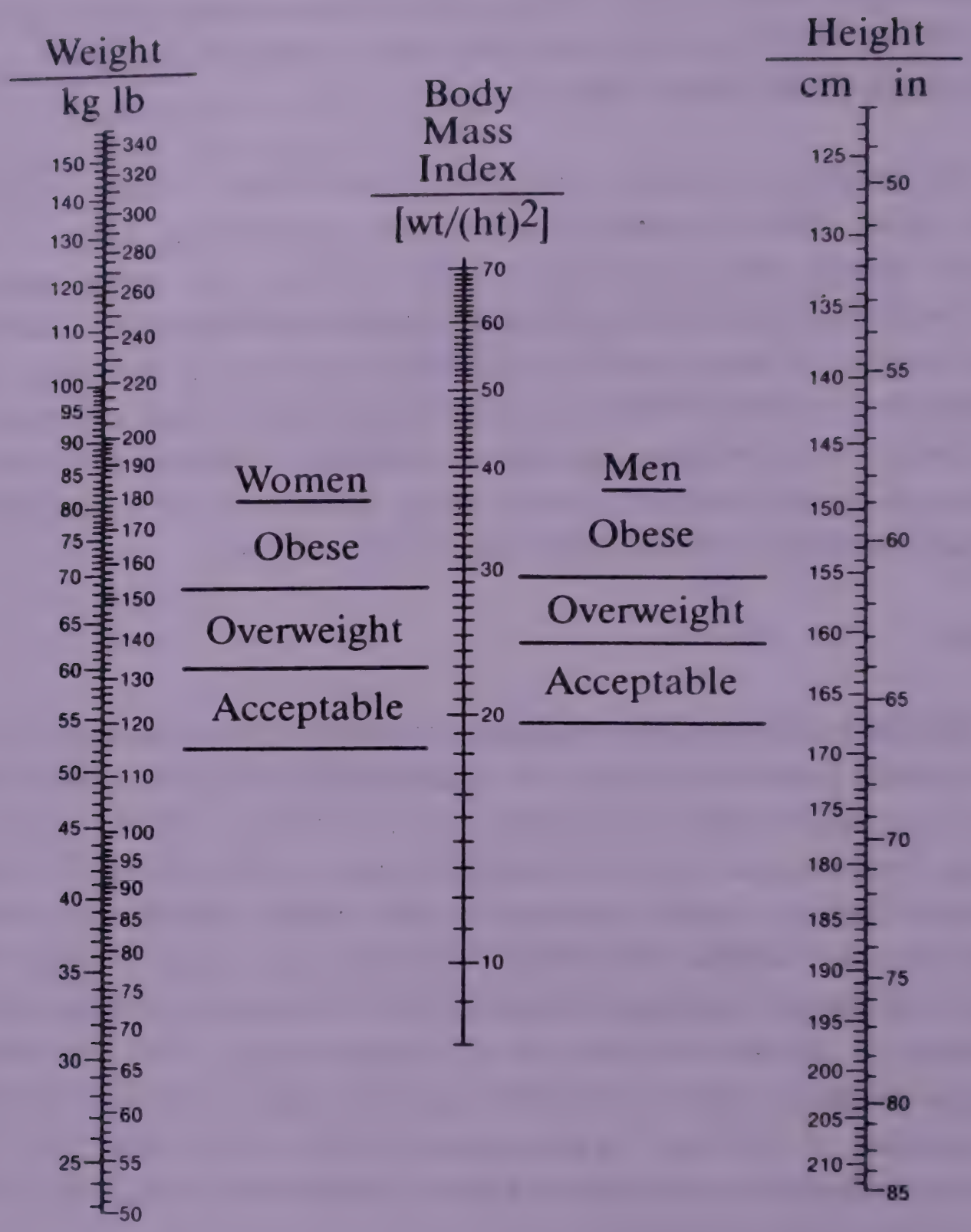
DIABETES

Diabetes is a disease wherein blood and urinary glucose increase (Table 4). *Insulin resistance* plays an important role in the development of the disease. Insulin resistance is a condition where blood glucose is not utilized by tissues and therefore blood sugar increases and the liver synthesizes more triglycerides. There are two major types of diabetes, *insulin dependent-diabetes mellitus* (IDDM) and *non-insulin dependent diabetes mellitus* (NIDDM). NIDDM is the most common and is associated with obesity. In diabetes blood lipids are increased and these contribute to *premature* or *accelerated* process of *atherosclerosis*. The prevalence of hypertension and heart disease is therefore higher in obese diabetics. Asians have a higher prevalence of NIDDM. Cardiovascular diseases are the major contributing factors to morbidity and mortality in diabetics. Diabetics are more prone to kidney damage, further raising blood pressure.

HYPERLIPIDEMIAS

Hyperlipidemias of *genetic origin* are different from diet-induced elevations of blood lipids. The enormous increase of blood lipids in hyperlipidemias is due to defects in certain metabolic processes. Therefore, in addition to regulating diets, drugs may be required to control the blood lipids.

Figure 6



A nomogram for determining Body Mass Index (BMI). To use this nomogram, place a ruler or other straight edge between the column for height and the column for weight connecting an individual's numbers for those two variables. Read the BMI in kg/m^2 where the straight line crosses the middle lines when the height and weight are connected. Overweight: BMI of 25-30 kg/m^2; obesity: BMI above 30 kg/m^2. Heights and weights are without shoes or clothes.

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Table - 3

RANGE OF BODY WEIGHT FOR ADULT MEN AND WOMEN (Kg.) FOR A GIVEN HEIGHT

Height (m)	A	B	C	Height (m)	A	B	C
1.30	31.3	42.3	50.7	1.65	50.4	68.1	81.7
1.31	31.8	42.9	51.5	1.66	51.0	68.9	82.7
1.32	32.2	43.6	52.3	1.67	51.6	69.7	83.7
1.33	32.7	44.2	53.1	1.68	52.2	70.6	84.7
1.34	33.2	44.9	53.9	1.69	52.8	71.4	85.7
1.35	33.7	45.6	54.7	1.70	53.5	72.3	86.7
1.36	34.2	46.2	55.5	1.71	54.1	73.1	87.7
1.37	34.7	46.9	56.3	1.72	54.7	74.0	88.8
1.38	35.2	47.6	57.1	1.73	55.4	74.8	89.9
1.39	35.7	48.3	58.0	1.74	56.0	75.7	90.8
1.40	36.3	49.0	58.8	1.75	56.7	76.6	91.9
1.41	36.8	49.7	59.6	1.76	57.3	77.4	92.9
1.42	37.3	50.4	60.5	1.77	58.0	78.3	94.0
1.43	37.8	51.1	61.3	1.78	58.6	79.2	95.1
1.44	38.4	51.8	62.2	1.79	59.3	80.1	96.1
1.45	38.9	52.6	63.1	1.80	59.9	81.0	97.2
1.46	39.4	53.3	63.9	1.81	60.6	81.9	98.3
1.47	40.0	54.0	64.8	1.82	61.3	82.8	99.4
1.48	40.5	54.8	65.7	1.83	62.0	83.7	100.5
1.49	41.1	55.5	66.6	1.84	62.6	84.6	101.6
1.50	41.6	56.3	67.5	1.85	63.3	85.6	102.7
1.51	42.2	57.0	68.4	1.86	64.0	86.5	103.8
1.52	42.7	57.8	69.3	1.87	64.7	87.4	104.9
1.53	43.3	58.5	70.2	1.88	65.4	88.4	106.0
1.54	43.9	59.3	71.1	1.89	66.1	89.3	107.2
1.55	44.4	60.1	72.1	1.90	66.8	90.3	108.3
1.56	45.0	60.8	73.0	1.91	67.5	91.2	109.4
1.57	45.6	51.6	73.9	1.92	68.2	92.2	110.6
1.58	46.2	62.4	74.9	1.93	68.9	93.1	111.7
1.59	46.8	63.2	75.8	1.94	69.6	94.1	112.9
1.60	47.4	64.0	76.8	1.95	70.3	95.1	114.1
1.61	48.0	64.8	77.8	1.96	71.1	96.0	115.2
1.62	48.6	65.6	78.7	1.97	71.8	97.0	116.4
1.63	49.2	66.4	79.7	1.98	72.5	98.0	117.6
1.64	49.8	67.2	80.7	1.99	73.3	99.0	118.8

James *et al.*, 1988.

Weight	BMI		
< A :	< 18.5	Underweight	- Less weight for height.
A - B :	18.5 - 25	Normal Weight	- Desirable range for good health.
B - C :	25 - 30	Over Weight	- Your health can suffer as age advances.
> C :	> 30	Obese	- Treatment needed.

Normal well-to-do Indian men and women have a BMI between 18.5-25. *(Gopalan, 1989).*

Table - 4

BLOOD GLUCOSE LEVELS

	Fasting		2 hrs after 75 g. glucose (oral)	
	Plasma mg %	Whole blood mg %	Plasma mg %	Whole blood mg %
Normal	< 100	< 80	< 140	< 120
Impaired glucose tolerance	100-140	80-120	140-200	120-180
Diabetes mellitus	> 140	> 120	> 200	> 180

WHO Technical Report Series No.727, 1985.

SMOKING

Smoking is a major risk factor leading to heart disease. *Nicotine* and *carbon monoxide* in the smoke damage the heart and blood vessels. Nicotine makes the heart beat faster and work harder, and therefore more oxygen is required. Carbon monoxide present in the tobacco smoke cuts down the oxygen carried by blood cells. Further, smoking increases blood viscosity as well as clot formation. In addition to coronary heart disease, smoking increases chronic lung diseases and lung cancers. Life expectancy is shorter in smokers. Smokers harm not only themselves but their neighbours as well.

SEDENTARY HABITS

With increasing industrialization, modernization and mechanization, sedentary habits have become part and parcel of our lifestyles. Sedentary habits *decrease* the *energy expenditure* and therefore contribute to *overweight* and *rise in blood lipids*. Exercise increases good (HDL) cholesterol. Therefore, physical exercise has an indisputable beneficial effect on health.

STRESS

It is well established that *ambitious and aggressive personalities* are more prone to cardiovascular diseases. Stress adversely affects other risk factors as well.

7. NUTRIENTS AND THEIR RECOMMENDED INTAKES

Though faulty dietary practices are implicated in chronic diseases, it is essential to remember that the foods we eat and the healthy dietary practices are the cornerstones of good health and vitality.

The foods provide several *macronutrients* (proteins, carbohydrates and fats) and *micronutrients* (vitamins and minerals) which when supplied in the right amounts support and sustain life and activity. A balanced diet (Table 5) provides these nutrients in proportions which satisfy the body needs according to age, sex, activity and physiological status (Tables 6a and 6b). Carbohydrates and fats are the primary sources of energy and provide calories or fuel potential. The fuel potential is a term used to indicate the chemical energy that is produced as heat when food is digested and metabolized.

Carbohydrates include starches, sugars and celluloses. One gram of carbohydrate provides 4 kcals. Carbohydrates are obtained through cereals, pulses, sugar, fruits and vegetables. Sugars are simple carbohydrates and are readily digested and absorbed. Starches being complex carbohydrates, require certain enzymatic reactions for conversion to simple sugars before they are absorbed.

Proteins are growth promoting and body building substances; they are essential for every function of the cell. These are found in cereals, pulses, animal foods such as flesh foods, organ meats and milk. Proteins consist of amino acids. Animal foods are ready sources of good quality proteins. However, combinations of plant foods like cereals and pulses can provide proteins of an equally good quality. One gram of protein provides 4 kcals.

Fats are concentrated sources of energy and provide twice the energy that carbohydrates and proteins furnish. They are needed for several functions and are sources of essential fatty acids. They also provide fat soluble vitamins and are necessary for their absorption. Fats give taste and flavour to the diet. Micronutrients namely vitamins and minerals participate in many vital metabolic processes in the body. These include fat and water soluble vitamins, minerals like iron, iodine, calcium and trace metals such as zinc, selenium etc.

Table - 5

A GUIDE TO A BALANCED DIET

	Vegetarian	Non-Vegetarian
Food Groups (g/person/day)		
Cereals/Millets	350 - 400	350 - 400
Pulses	40 - 50	30 - 40
Milk (ml)	200 - 250	150 - 200
Green leafy vegetables	50 - 100	50 - 100
Other vegetables	60 - 75	60 - 75
Roots and Tubers	70 - 100	70 - 100
Fats and Oils	20 - 40	20 - 30
Fruits	50 - 100	50 - 100
Sugar	20 - 30	20 - 30
Meats	-	40 - 60
Fish*	-	100 - 200
Egg*	-	One
Nutrients		
Calories (kcal)	1800 - 2400	1800 - 2400
Carbohydrates (g.)	300 - 340	300 - 340
Proteins (g.)	50 - 60	50 - 70
Fats (g.) (Visible + Invisible)**	40 - 60	40 - 60

You can use a varied diet, choosing some foods from each major group in amounts appropriate for activity and lifestyle.

* These items can be taken 2-3 times a week. ** See page 25.

Gopalan *et al.*, 1989.

A Report of the Expert Group of the Indian Council of Medical Research, 1989.

Table - 6

RECOMMENDED DIETARY ALLOWANCES FOR INDIANS (Per Day)

a: Macronutrients, calcium and iron

Work Pattern		Body wt. kg.	Net energy Kcal.	Protein g.	Fat g.	Calcium mg.	Iron mg.
Man	Sedentary		2425				
	Moderate	60	2875	60	20	400	28
	Heavy		3800				
Woman	Sedentary		1875				
	Moderate	50	2225	50	20	400	30
	Heavy		2925				

b. Micronutrients

Work Pattern	Body wt.	Vitamin A µg/day		Thia-min	Ribo-flavin	Nico-tinic acid	Pyri-doxin	Ascor-bic acid	Folic acid	Vit. B_{12}
	kg.	Reti-nol	β-caro-tene	mg.	mg.	mg.	mg.	mg.	µg.	µg.
Man										
Sedentary				1.2	1.4	16				
Moderate	60	600	2400	1.4	1.6	18	2.0	40	100	1
Heavy				1.6	1.9	21				
Woman										
Sedentary				0.9	1.1	12				
Moderate	50	600	2400	1.1	1.3	14	2.0	40	100	1
Heavy				1.2	1.5	16				

A Report of the Expert Group of Indian Council of Medical Research, 1989.

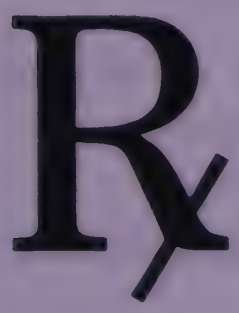
It is necessary to remember that no single item of food can be considered as good or bad. Some foods are clearly healthier than others. However, *diets can be good or bad* depending on the quantity and relative proportions of the individual food items present. *Nutrients* in *excess* can also be *toxic*. Single nutrients given for long periods can upset the metabolic processes. It is desirable to obtain all nutrients from the daily diet in balanced amounts. A judicious combination of naturally available varieties of food substances will provide them in adequate amounts.

Foods fall into the following major dietary groups. These are :

- Energy yielding foods such as cereals, millets, sugar, jaggery, fats and oils.
- Body building foods such as pulses, flesh foods, milk and oilseeds.
- Protective foods such as vegetables, fruits and milk.

The quantity of each food group that one requires depends on age, sex, physiological status and physical activity. A guide to a balanced diet for Indian adults weighing between 50-60 kg. and engaged in sedentary work is given in Table 5.

8. DIETARY PRESCRIPTIONS



EAT FOR A HEALTHY HEART
DON'T EAT YOUR HEART

MAINTAIN BODY WEIGHT APPROPRIATE FOR YOUR HEIGHT

Body weight is directly proportional to calorie intake.

Energy intake minus energy expenditure equals gain in body weight.

Excess carbohydrates, proteins and fats in the diet can increase body weight. However, excess dietary fat makes you more fat.

Fat around the abdomen is more dangerous than fat around the hips. Keep your waistline trim. Maintain the waist-to-hip ratio < 1 (man) and < 0.8 (woman).

Refined foods and empty calories from sugar increase blood sugar and triglycerides.

Weight reducing diets must be low in total calories and yet ensure optimum intake of all nutrients. However, very low calorie diets (300-400 kcal/day) are harmful.

Weight reduction should be gradual, not more than 0.5 to 1 kg/week.

Diet restriction should be combined with exercise.

Remember, 100 Kilocalories in excess/day can increase your body weight approximately by 4 kg in one year.

Beware ! Count your calories, cut down fried snacks and sugar.

DIETARY HABITS ARE LEARNT IN EARLY CHILDHOOD AND ARE DIFFICULT TO CHANGE AFTERWARDS.
MOTHERS SHOULD REFRAIN FROM OVERFEEDING THEIR CHILDREN.

REDUCE FAT INTAKE AND MAINTAIN QUALITY

The best way to maintain ideal body weight is to cut down fat intake.

Know your source

Foods in general contain two types of fats namely "visible fats" and "invisible" or "hidden" fats.

Visible fats are fats extracted from oilseeds (vegetable oils), adipose tissue of animals, milk (animal fats) and fish livers (fish oils). All these are in fact the storage (depot) fats of plants and animals. Generally, fats are solid and oils are liquid, but both fat and oil mean the same thing. The following are the examples of various visible fats.

a) Vegetable fats/oils : Coconut, corn, cottonseed, groundnut, mustard, palm, rice bran, safflower, sesame, soyabean, sunflower and hydrogenated vegetable oils (Vanaspati).

b) Animal fats : Butter and ghee.

c) Fish oils : Shark and cod liver oils.

Invisible or hidden fats are those which form an integral part of foods and are therefore not visible. It includes the fats present in the cells and cell walls and membranes of both plant and animal tissues. Almost everything we eat as listed below carries some invisible fat.

a) Plant foods : Cereals, millets, pulses, vegetables, spices, nuts and oil seeds, coconuts, tubers and fruits (Table 7).

b) Animal foods : Milk and milk products (curd, cheese, cream), flesh foods (mutton, beef, pork, chicken), organ meats (brain, liver, kidney) fish, shrimp and prawn.

Table - 7
INVISIBLE FAT AND FATTY ACIDS IN PLANT FOODS
(g/100 g. Edible Portion)

	Fat	Linoleic acid[a]	Alpha-linolenic acid[b]
Cereals			
Rice (polished)	2	0.5	0.01
Wheat	3	1.0	0.17
Millets			
Ragi	2	0.3	0.05
Jowar	3	1.5	0.05
Maize	5	2.0	0.05
Bajra	6	2.0	0.13
Legumes and Pulses			
Blackgram (urad)	2	0.1	0.70
Rajmah	2	0.4	0.70
Cowpea (lobia)	3	0.8	0.50
Greengram (mung)			
Lentil (masoor)	2	0.8	0.16
Redgram (tuar)			
Bengalgram (chana)	7	3.5	0.2
Soya	20	8.0	1.0
Condiments and Spices			
Dry chillies			
Cumin seeds	16	5.0	0.2
Coriander seeds			
Fenugreek seeds	10	3.5	2.0
Vegetables			
Green leafy vegetables	0.4	0.04	0.15
Other vegetables	0.2	0.06	0.03
Nuts and Oilseeds			
Groundnuts	40	10	<0.2
Sesame	40	16	0.4
Coconut (fresh)	40	0.6	-
Mustard	40	5	3.5
Almonds	56	14	0.3
Cashewnuts	50	9	0.3

[a] : Linoleic is a n-6 polyunsaturated fatty acid.
[b] : alpha-linolenic is a n-3 polyunsaturated fatty acid.
Ghafoorunissa 1989a, Ghafoorunissa and Pangrekar, 1993

The chemical composition of fats/oils

Fatty acids : Dietary fats and oils are combinations of glycerol with fatty acids (triglycerides). The storage fats of both plants (nuts and oilseeds) and animals (depot fats) are triglycerides. The structural fats (cell wall, cell membrane, tissue) and milk fats are made up of triglycerides, phospholipids (alpha-glycerophosphate combined with fatty acids) and cholesteryl esters (esters of fatty acids with cholesterol). The fatty acids are of different carbon chain length and may be either saturated or unsaturated. The unsaturated fatty acids may carry one, two, three or more double bonds. Because of the many different fatty acids, there is a great variety in the structure of individual fats and oils. They also have different nutritional properties. Fats are grouped as saturated or polyunsaturated fats depending on the predominating fatty acids. Whether fats are solids or liquids at room temperature is largely determined by the degree of their unsaturation. The more the saturation the harder and more solid is the fat.

The important saturated fats are :

a) Plants : Coconut oil, hydrogenated vegetable oils, palm kernel oil (Table 8).

b) Animals : Butter, ghee, fats from flesh foods and organ meats (Table 9).

Unsaturated fats/oils have oleic (monounsaturated), linoleic and alpha-linolenic acids (polyunsaturated fatty acids, PUFA) in various proportions. Important sources of unsaturated fats are as follows :

a) Plants : All common vegetable oils with the exception of coconut oil are predominantly unsaturated. So are the invisible fats present in nuts and oilseeds, cereals, pulses and legumes, roots and tubers, vegetables, spices and fruits (Table 7). In most plant foods and vegetable oils, linoleic acid is the predominant PUFA, but mustard and soyabean oils, legumes/pulses, fenugreek seeds and green leafy vegetables are good sources of alpha-linolenic acid (Tables 7 and 8). Mustard oil contains a unique fatty acid called erucic acid not found in other oils.

b) Animals : The muscle (lean meat) of flesh foods, unlike the depot fat surrounding the tissues, is mainly composed of cholesteryl esters and phospholipids, both of which have a high proportion of long chain n-6 PUFA which are otherwise formed in the body from linoleic acid. Arachidonic acid (20 carbon fatty acid with

four double bonds) is the major long chain n-6 PUFA in animal and human cells. It has higher biological activity than linoleic acid. Fish and fish oils provide long chain n-3 PUFA (eicosapentaenoic and docosahexaenoic acids). The long chain n-3 PUFA are formed in human cells from alpha-linolenic acid and are biologically more active than alpha-linolenic acid (also see page 37).

Table - 8

APPROXIMATE FATTY ACID COMPOSITION OF COMMON FATS AND OILS (g/100 g.)

	Saturated	Mono-un-saturated	Linoleic	Alpha linolenic	Predominant fatty acids
Coconut[a]	90	7	2	<0.5	Saturated
Palm kernel	82	15	2	<0.5	Saturated
Ghee[a,b]	65	32	2	<1.0	Saturated
Vanaspati[b]	24	19	3	<0.5	Saturated
Red palm oil (raw)	50	40	9	<0.5	Saturated + Monounsaturated
Palm oil	45	44	10	<0.5	Saturated + Monounsaturated
Olive	13	76	10	<0.5	Monounsaturated
Groundnut	24	50	25	<0.5	Monounsaturated
Rape/Mustard[c,d]	8	70	12	10	Monounsaturated
Sesame	15	42	42	1.0	Mono and poly-unsaturated
Rice bran	22	41	35	1.5	Mono and poly-unsaturated
Cotton seed	22	25	52	1.0	Polyunsaturated
Corn	12	32	55	1.0	Polyunsaturated
Sunflower	13	27	60	<0.5	Polyunsaturated
Safflower	13	17	70	<0.5	Polyunsaturated
Soyabean[d]	15	27	53	5.0	Polyunsaturated

[a] : Mainly short and medium chain fatty acids (Coconut 77%, Ghee 25%).
[b] : Trans fatty acids (Ghee 2%, Vanaspati 53%).
[c] : Long chain monounsaturated fatty acids (50% erucic acid and 5% eicosenoic-acid).
[d] : Good source of alpha-linolenic acid.

Table - 9

FATTY ACID COMPOSITION AND CHOLESTEROL CONTENT OF ANIMAL FOODS* (g/100 g. Edible Portion)

Item	Fat g/100 g.	Saturated fatty acids g/100 g.	Cholesterol mg/100 g.
Butter	80	50	250
Ghee	100	65	300
Milk (cow)	4	2	14
Milk (buffalo)	8	4	16
Milk (skimmed)	0.1	-	2
Milk (condensed)	10	6	40
Cream	13	8	40
Cheese	25	15	100
Egg (whole)	11	4	400
Egg yolk	30	9	1120
Chicken without skin	4	1	60
Chicken with skin	18	6	100
Beef	16	8	70
Mutton	13	7	65
Pork	35	13	90
Organ meats			
Brain	6	2	2000
Heart	5	2	150
Kidney	2	1	370
Liver	9	3	300
Fresh water & Sea foods			
Prawns/shrimps	2	0.3	150
Fish (lean)	1.5	0.4	45
Fish (fatty)	6	2.5	45

* Values vary depending on the feed of the animals.

a One whole egg or yolk of one egg contains 210 mg. cholesterol.

Gopalan *et al.*, 1989; McCance and Widdowson, 1993.

Cholesterol is a constituent of animal foods (Table 9) but is absent in plants. Vegetable oils do not have cholesterol. In human diets, cholesterol is obtained from ghee, butter, cheese, milk, curd, egg, flesh foods, organ meats, fish and prawns. Since cholesterol is synthesized in the body, it is not a dietary essential. Most of the animal foods are good sources of both cholesterol and saturated fatty acids. However, egg is a rich source of linoleic acid. High intakes of cholesterol increase blood cholesterol. The blood cholesterol elevating effect of dietary saturated fatty acids increases with increase in cholesterol intake. Therefore, it is best to keep the cholesterol intake as low as possible.

Non-fat components : Natural fats also contain small amounts of non-fat components. These include hydrocarbons, sterols, carotenoids and vitamin E (tocopherols). The natural flavour and characteristic smell of the oil is largely due to the presence of non-fat components. Vitamin E functions as an antioxidant and delays the development of rancidity. Some of the non-fat components have beneficial effects on health. Most of them like vitamin E in all vegetable oils, tocotrienols in palm oil, tocotrienol and oryzanol in rice bran oil reduce blood cholesterol. Vitamin E and tocotrienols also have anti-oxidant effect in tissues (also see page 36).

What does refining do ?

Refining is a process of purifying fats and oils. The process removes suspended and colloidally dissolved matter, toxic substances, free fatty acids, colour and odour. However, the fatty acid composition of the oil is not altered. Refined oils lose their characteristic taste, but are more stable and aesthetically pleasing. In India, certain oils whose flavour is considered important like sesame, coconut and mustard are preferred to be used without being refined.

Why are fats hydrogenated ?

Vanaspati is produced in India by the hydrogenation of vegetable oils. The process of hydrogenation (addition of hydrogen at the double bonds), converts liquid oils into semi-solid or solid fats. During hydrogenation, linoleic and alpha-linolenic acid present in the oils are converted to trans fatty acids and saturated fatty acids. Also the monounsaturated fatty acids in the oils are converted to saturated fatty acids. Traditionally ghee has been the favourite choice in Indian cooking for its excellent flavour and long shelf life. Hydrogenated fats were at first designed to imitate ghee. As in ghee, foods cooked in hydrogenated fats also have a long shelf life, though

without the aroma and taste of ghee. Hydrogenated fats are used in making processed foods like biscuits and cakes.

Saturated fats are resistant to oxidation even at frying temperatures. Since polyunsaturated fats are more easily oxidized, foods prepared in these fats tend to become rancid quickly. Also prolonged or repeated heating of polyunsaturated fats produce toxic substances (polymerized products, peroxides, free radicals, etc.). However, from the point of health, use of too much saturated and trans fatty acids can increase blood cholesterol and promote atherosclerosis.

How much fat do we need ?

An adult man consuming 2400 Calories requires a minimum of 40 g. (15% calories) fat. In a typical Indian diet which is cereal based, about 20 g. is obtained as invisible fat. Therefore, a daily intake of 20 g. or 4 teaspoons of visible fat is needed.

Diets providing more than 30% calories from fat increases the risk of atherosclerosis. Therefore this level is the upper limit of total fat in the diet. In order to keep the total dietary fat below 30% of the total calories, the visible fat intake (cooking oils, ghee and butter) should be kept below 50 g. or 10 teaspoons per day. In individuals with risk factors for atherosclerosis, it is necessary to keep the visible fat intake to a lower limit of 20 g.

What fat/oil should we use ?

Dietary fat affects the risk of heart disease through several mechanisms. High intakes of saturated fatty acids increase blood levels of total and LDL cholesterol and accelerate the processes of atherosclerosis and thrombosis. Saturated fatty acids also increase blood pressure and arrhythmias. On the other hand polyunsaturated fatty acids have opposite effects. The relative balance of linoleic and alpha-linolenic acids (and their respective long chain PUFA) is important for prevention of blood clotting and also for several physiological functions in the body. In view of the above, it is important to obtain the right amount of different fatty acids in the diet and avoid excess intake of any one group of fatty acids. In the guidelines for prevention of heart disease, the suggested upper limits are saturated fatty acids 8-10% of total calories, polyunsaturated fatty acids 5-8% of total calories and monounsaturated fatty acids would contribute the difference. The desirable polyunsaturated/saturated fatty

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acid ratio is about 0.8 to 1.0 and polyunsaturated fatty acids of both types should be included so as to provide linoleic/alpha-linolenic acid ratio around 5-10. In order to ensure this quality of fat in Indian diets, the choice of cooking oils should be as follows :

* Use an oil which has moderate amount of linoleic acid (groundnut or ricebran or sesame)

or

* use an oil which has high amount of linoleic acid (safflower, sunflower, cottonseed or corn) along with an oil which has relatively low levels of linoleic acid like palm oil.

or

* use any of the above oils with alpha-linolenic acid containing oil (mustard, soyabean).

However, this does not necessarily mean that the oils should be blended and used, the purchases can be made for the entire month and the relatively less unsaturated oil should be used for frying. The quality of fat in the total diet can be further improved by regular consumption of foods which are good sources of alpha-linolenic acid or by eating about 100-200 g. fish twice a week (Table 10).

Table - 10

RICH SOURCES OF ALPHA-LINOLENIC ACID

Cereals and Millets	:	Wheat, bajra
Pulses and Legumes	:	Blackgram, cowpea (lobia), rajmah, soya
Vegetables	:	Green leafy
Spices	:	Fenugreek (methi), mustard (rai)
Oils	:	Mustard, soyabean
Animal foods	:	Fish[a]

[a] Long chain n-3 PUFA - biologically active product of alpha-linolenic acid.

FAT FROM VARIED SOURCES IS BETTER THAN ANY SINGLE KIND BUT MODERATE THE TOTAL INTAKE

HOW TO REDUCE FAT AND MAINTAIN QUALITY

	Facts on Fats	Ensure Right Quantity and Quality
1.	Fats are necessary but excess is dangerous	Moderate the total fat intake Limit visible fat and cut down invisible fat from animal foods.
2.	Saturated fats (visible) and the invisible fats present in animal foods increase blood cholesterol and blood clotting.	Select low fat milk, limit/avoid cheese, all types of meats, butter, ghee and hydrogenated oils.
3.	Trans fatty acids increase blood cholesterol.	Limit/avoid hydrogenated oils.
4.	Vegetable oils and all plant foods do not have cholesterol Monounsaturated fats decrease blood cholesterol Polyunsaturated fats (PUFA) decrease blood cholesterol and suppress clot formation in blood.	Prefer plant foods and vegetable oils.
5.	The ratio of saturated to polyunsaturated fats should be roughly 0.8 to 1.0.	This can be achieved by a judicious combination of cereals, pulses, vegetables, milk and vegetable oils.
6.	A good balance of linoleic (n-6) and alpha-linolenic (n-3) acids is essential.	Use of mustard oil or soyabean oil along with other oil(s) will help to achieve this. Also eat plant foods that are good sources of alpha-linolenic acid. (Table 10).
7.	Long chain n-3 PUFA found in fish and fish oils lower blood cholesterol, triglycerides and prevent clot formation. They also lower blood pressure and have several other beneficial effects.	Those who like fish should take 100-200 g. twice a week. For those who do not like fish, guideline 6 should suffice.
8.	Carbohydrates, particularly refined sugars, increase triglycerides.	Prefer natural foods, and reduce sugars.
9.	Certain types of dietary fibres decrease cholesterol and triglycerides.	Cereals, pulses, vegetables and fruits are rich sources of soluble fibres, besides furnishing some fat of good quality.

USE NATURAL PLANT FOODS

The use of natural plant foods i.e., foods "as grown" offers several advantages. Plant foods are rich sources of fibre, which have several health benefits. Plant foods have less fat and sodium and negligible amounts of cholesterol and provide roughage. Further, they are good sources of vitamins and minerals. Refined foods are generally poor in fibre, vitamins and minerals.

What are fibres and what do they do ?

Dietary fibres are plant constituents that are resistant to digestion in the human digestive tract. They consist of cellulose, hemicellulose, pectin, mucilages, gums and lignin. All except lignin are complex carbohydrates. There are two types of dietary fibre. Insoluble fibres include cellulose, hemicellulose and lignin, and soluble ones are pectins, gums and mucilages.

Fibre has several functions. Apart from making the diet bulky, it delays the absorption of carbohydrates and fats and therefore has satiety value. It also binds toxic substances. Soluble fibres bind to water and increase the viscosity of the intestinal contents, they bind cholesterol and increase excretion of bile acids and also affect the metabolism of other nutrients. Insoluble fibre moves the food through the gastrointestinal tract more quickly and increases the bulk of the stools. They have no metabolic effects. However, too much of fibre can decrease the absorption of valuable micronutrients. Fibre rich foods are usually low in fat. On high fibre diets, one is less likely to overeat.

Different parts of the plant contain varying amounts of fibre but older plants contain more than younger plants. The skin and the outer layers of the edible portion of foods contain more fibre. Traditional cooking habits retain fibre. During refining of foods, fibre is removed and hence is less in processed foods. Fibre containing plant foods are important for decreasing the risk of metabolic disorders such as diabetes and cardiovascular diseases, and also diverticulitis and colon cancer. Fibre protects vitamins from being destroyed during cooking.

How to ensure adequate fibre intake ?

The desirable levels of dietary fibre are around 30-40 g. a day. Western diets high in processed foods are low in fibre (20 g.) and therefore this population is

advised to increase the intake of foods rich in fibre. Indian diets provide 50-100 g./day, when whole grain cereals, pulses and vegetables are consumed daily, the actual quantity depending upon the nature of cereals and millets used (Table 11). It is therefore to our advantage to maintain our traditional cooking and eating patterns. Whole wheat flour (without sieving) should be used for preparing roti. The use of white bread, naan, roomali roti and other maida preparations should be limited. Whole legumes should be used at least twice a week. Fruits may be used with edible skin. It is advisable to limit/avoid processed, refined and fast foods. Certain Indian spices, such as fenugreek (methi) have high fibre content and are useful in reducing blood glucose, cholesterol and triglycerides. Simple recipes based on fenugreek seeds can be employed to improve carbohydrate tolerance and reduce blood lipids in patients with diabetes and high blood levels of cholesterol and triglycerides.

Table - 11
TOTAL FIBRE CONTENT OF COMMON FOODS (g/100 g.)

High (> 10)	Medium (1 to 10)	Low (< 1)	Nil
Wheat	Rice	Refined	Sugar
Jowar	Most vegetables	and Processed	Fats/oils
Bajra	Most fruits	foods	Milk
Ragi	Coconut		All types of meat
Maize	Sesame (til)		
Legumes			
Dhals			
Fenugreek			

Kamath and Belavady, 1980.
McCance & Widdowson, 1993.

TRADITIONAL EATING HABITS PROVIDE MORE FIBRE IN THE DIET

USE FRESH FRUITS AND VEGETABLES

Ageing, cancer and heart diseases are currently thought to be a result of oxidative stress, i.e., the generation of excess of free radicals and peroxides in the tissues. These substances oxidize several blood constituents including lipids. Oxidized

blood lipids are more atherogenic than unoxidized lipids. Antioxidants and micronutrients such as vitamin C, beta-carotene (provitamin A), vitamin A, vitamin E and selenium can remove peroxides and free radicals and thereby reduce the oxidative stress in tissues. Vegetables and fruits are delicious *natural capsules* of *vitamins* and *minerals* offering protection against heart disease and cancer. They are low in calories and fat and provide fibre. Although each type of vegetable and fruit provides an abundance of nutrients, those which are yellow, orange and green in colour are the principal dietary sources of antioxidants and other micronutrients (Table 12). It is best to use fresh, raw fruits and enjoy taking vegetables which can be taken raw (salad). It is also important to avoid unnecessary peeling and slicing of fruits and vegetables because nutrients are concentrated close to the skin. Most root vegetables need only scrubbing. The washing and cooking practices reduce/destroy the nutrients in vegetables. It is therefore important to wash vegetables before cutting/chopping and not to leave cut vegetables soaked in water (the surface area increases for nutrients to leach out into water). Instead of overcooking vegetables they should be cooked with minimum water (or oil) until they become tender. Do not re-heat often.

Table - 12
RICH SOURCES OF MICRONUTRIENTS AND ANTIOXIDANTS

Beta-carotene
- Yellow and orange vegetables and fruits
- Green leafy vegetables
- Egg
- Red palm oil

Vitamin A
- Milk fat
- Egg yolk, liver, kidney
- Vanaspati which is fortified

Vitamin C
- Fresh fruits
- Green leafy vegetables
- Other vegetables

Vitamin E
- Vegetable oils
- Green leafy vegetables
- Cereals
- Egg yolk

Selenium
- Cereals and pulses
- Spices

THE MORE VARIETY YOU ENJOY, THE BETTER IT IS, BUT TAKE CARE TO RETAIN ALL THE IMPORTANT NUTRIENTS

FISH IS GOOD FOR THE HEART

A growing interest in fish eating has been prompted by the observation that *Eskimos*, whose diet consists largely of *fish*, rarely suffer from heart diseases. Further observations on fish eating population support the protective role offered by fish. Fish is an abundant source of *long chain n-3 PUFA*. These fatty acids decrease the fibrinogen levels, inhibit the activity of platelets and the clotting process. Excess fibrinogen is known to be associated with strokes and heart attacks. In addition, these fatty acids reduce the blood levels of cholesterol and triglycerides. They modify inflammatory reactions in the arterial wall and also decrease blood pressure. Most of the beneficial effects of fish or fish oil capsules are mediated through their effects on the *eicosanoids*. The eicosanoids are a group of biologically very active compounds formed in the body cells from long chain n-3 PUFA and long chain n-6 PUFA.

Both fresh water and sea fish are excellent for the heart. Fish are of two types. Many are the so called lean fish which store fat as triglycerides in their livers. Fish liver oils are prepared from shark and cod. Fatty fish like seer, purava and hilsa have triglycerides stored in the muscle. A regular habit of including 100-200 g. of fish twice a week is recommended as a preventive dietary approach for heart diseases. Both lean and fatty fish are good, though fatty fish will provide more fat and thus more long chain n-3 PUFA (Table - 13).

Plant foods (Tables 7 and 10) such as wheat, black gram (urad), rajmah, cowpea (lobia), soyabean, pulses in general, spices such as mustard (rai), fenugreek seeds (methi) and green leafy vegetables are good sources of alpha-linolenic acid which gets converted in the body to long chain n-3 PUFA. Mustard and soyabean oils are two common vegetable oils which contain alpha-linolenic acid. Therefore, use of any one of these oils along with other oils will be beneficial.

The n-3 PUFA are not only good for the heart but they are also good for the brain and the joints (prevent arthritis) and have anti-cancer properties. Fish oil capsules which provide a concentrated source of long chain n-3 PUFA are recommended for patients with heart disease and arthritis. However, as a long term preventive measure, it is obviously more desirable to obtain alpha-linolenic acid (plant foods) and long chain n-3 PUFA (fish) through foods.

Table - 13

FAT CONTENT OF EDIBLE MUSCLE TISSUE OF FISH CONSUMED IN INDIA (g/100 g.)

Fatty fish			
Hilsa	19	Pomfret (white)	1.3
Purava	6	Mackerel	1.8
Seer	4	Bam	0.9
		Bombay duck	0.8
Lean fish		Bhekti	0.8
Pomphret (black)	2.6		
Murrel	1.3		
Katla	2.4		
Rohu	1.4		

Approximate fatty acid composition of fish fats

Saturates	-	40%.	Monounsaturates	-	25%.
PUFA (n-6)	-	10%.	PUFA (n-3)	-	25% (mainly long chain)

Gopalan, *et al.*, 1989.

EXCESS SALT IS BAD FOR THE HEART

Salt or sodium chloride gives a distinct taste to food. Sodium keeps the body fluids in balance. Since sodium is widely distributed in natural foods, salt itself is not an essential food item. Human kidneys conserve sodium. Therefore, excess salt taken in the diet is retained and is likely to precipitate hypertension. Man's requirement for sodium has been *debated* since the beginning of medical practice. Adding salt to food is an *acquired habit* and not an inborn trait. Societies differ greatly with respect to the amount of sodium consumed, which is related to food habits. Intake of as little as 3 g/day is probably both safe and adequate for healthy adults. Even in tropical countries like India, where sodium loss can occur through sweat, the requirements are probably not more than 7 g/day.

By *reducing salt* you can *control blood pressure*. Drugs like diuretics, known to increase salt excretion bring down the blood pressure. In primitive societies where the intake of salt is less than 2 g/day, hypertension is a rare phenomenon, whereas

in societies where the salt intake is between 10-20 g/day the disease occurs more often, with severe consequences such as *strokes* and *heart diseases*. Since taste for salt is an acquired habit, it should be possible to cut down its intake gradually without much difficulty and maintain it thereafter.

Indians are in the habit of consuming 10-15 g. of salt/day in the form of added salt. This is much higher than the amount of salt present naturally in foods. Therefore it is only by cutting down the added salt its intake can be substantially reduced. In order to restrict salt intake it is essential to avoid preparations that are high in added salt (Table 14). Patients with very high blood pressure may have to restrict the intake of high sodium containing foods.

Table - 14

PREPARATIONS HIGH IN ADDED SALT

Pickles, chutneys, sauce and ketchups
Papads, chips and salted biscuits
Savoury items
Cheese and salted butter
Canned vegetables
Readymade soup packets
Dried salted fish

REDUCTION IN SALT INTAKE IS BEST ACHIEVED BY CUTTING DOWN THE USE OF ADDED SALT

ALCOHOL AND THE HEART

Alcoholic beverages such as whisky, brandy, rum, wines, beer, etc., contain ethyl alcohol in varying proportions (Table - 15). Alcohol increases *blood pressure* and heavy drinking weakens the heart muscle (cardiomyopathy).

Table - 15

ETHANOL CONTENT OF ALCOHOLIC BEVERAGES

Beer	2 - 5%
Wine	8 - 10%
Fortified wines	
Sherry	13 - 20%
Vermouth	
Spirits	
Whisky	
Brandy	30 - 40%
Rum	

1 ml ethanol = 7 Kcals

Alcohol is a source of empty calories (without vitamins, minerals and proteins) and can be turned into fat, adding weight to the body. It increases the level of blood triglycerides. Though alcohol in small amounts (a large glass of beer, 35 ml of whisky, 70 ml of wine) increases HDL, it does not increase the protective fraction (HDL_2). The non-alcoholic components in wine prevent LDL oxidation. However, it is best to avoid drinking because of its other effects on blood vessels and muscles of the heart.

Alcohol is a *social evil* - an innocent social habit which can become a serious *addiction*. It adds to problems at home and work, to crimes and accidents. In addition to the heart, alcohol also damages the liver, brain and nervous system and is causally related to cancers. It is sensible to avoid alcohol altogether for your sake and for the sake of others.

AVOIDING ALCOHOL HAS SEVERAL ADVANTAGES BOTH FOR THE INDIVIDUAL AND THE SOCIETY

COFFEE AND THE HEART

Caffeine can be considered to be mankind's most *popular drug*, consumed mainly through coffee and tea. The concentration of caffeine depends upon how the beverage is prepared. On an average, a cup (150 ml) of percolated coffee has 120 mg of caffeine, a cup of instant coffee - 70 mg, and a cup of tea - 50 mg. Bottled cola drinks contain 30-60 mg of caffeine. Population studies show an association between coffee consumption and elevated levels of total and low density lipoprotein cholesterol, triglycerides and heart diseases. Use of coffee increases *blood pressure* and produces heart beat abnormalities *(arrythmias)*. It is good to limit coffee consumption to 3 cups or less per day.

WATER

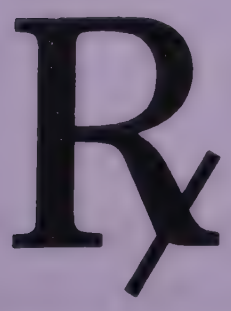
Though there is no consensus about the role of water in heart disease, some scientific evidence suggests that heart diseases are more common in areas with soft water than where the water is hard. Minerals such as calcium and magnesium, and trace metals like chromium and vanadium present in hard water, appear to be protective. Soft water which contains copper and low levels of calcium may not be desirable. Pollutants such as lead and cadmium in water are harmful.

THE BEST DRINK WITH MEALS AND IN BETWEEN MEALS IS UNDOUBTEDLY WATER

ONION AND GARLIC

In scientific studies, large doses of onion and garlic are noted to be beneficial, causing a decrease in blood lipids and glucose and an increase in clot dissolution (fibrinolytic). Onion and garlic also have anti-carcinogenic and antibiotic properties. As *regular dietary* constituents the small amounts that are included in Indian diets, may also have beneficial effects. One may as well eat garlic as part of daily diet rather than resort to garlic capsules.

9. NON DIETARY PRESCRIPTIONS



EXERCISE FOR A HEALTHY HEART

Physical activity is a prerequisite for health. It increases energy expenditure, improves blood circulation and tones up the muscles. Exercise relieves tension and helps one to relax and sleep properly. It increases physical, mental and social well being. Physiologically speaking, exercise increases the electrical stability of the heart and decreases blood glucose, blood pressure and blood lipids. It increases HDL cholesterol (good cholesterol) and reduces the tendency of the blood to form clots. Regular exercise helps the body to make the best use of fats and sugars. People who are physically active appear to choose healthy lifestyles, with less craving for smoking and alcohol.

Exercise should become a part of one's daily routine. It is best to keep oneself physically fit by doing some of the daily routines in the house such as gardening, dusting, sweeping, scrubbing, mopping, washing clothes etc. (Table 16). The exercise programme should be such that it enables one to spend around 2000 kcals per week over and above their routine energy expenditure. It is not advisable to begin with vigorous exercises. The exercise programme should be gradual and stepped up slowly. Brisk walking, hiking, jogging, swimming, skipping are active aerobic exercises. The exercise schedule should be preceded by a warm-up, and followed by a cool down procedure. It is best to consult a doctor before starting exercises.

WALKING BRISKLY FOR HALF-AN HOUR A DAY
AT LEAST 3-4 TIMES PER WEEK CAN BRING DOWN THE RISK

Table - 16

CALORIE COST OF VARIOUS ACTIVITIES FOR 60 Kg. PERSON

Activity		Energy expenditure (BMR Multiple Factor)
Sleeping Resting Relaxing in bed	:	1
Sitting (watching T.V.)	:	
Eating	:	
Listening	:	1.5
Writing	:	
Reading	:	
Talking	:	
Standing	:	
Washing face	:	
Brushing teeth	:	
Toiletting	:	2.3
Shaving	:	
Combing	:	
Cooking	:	
Feeding/dressing the child	:	
Knitting	:	
Sitting (office work)	:	
Watering plants	:	
Social walking (4 km/hr.)	:	
Driving	:	
Dressing	:	
Bathing	:	2.8
Marketing	:	
Sewing (machines)	:	
Dusting	:	
Feeding Pets	:	

Activity		Energy expenditure (BMR Multiple Factor)
Sweeping	:	
Window washing	:	
Washing vessels	:	3.3
Bathing children	:	
Mopping	:	
Washing clothes	:	
Other house chores	:	
Baseball	:	
Golf	:	
Volleyball	:	4.8
Cycling	:	
Table tennis	:	
Brisk walking	:	
Lift weight (bucket full load)	:	
Walking upstairs	:	
Gardening	:	
Mining	:	
Carpenting	:	
House building	:	5.6
Wood cutting	:	
Plumbing	:	
Walking upstairs (with load)	:	
Grass cutting	:	
Harvesting	:	
Dancing	:	
Gymnastics	:	
Swimming	:	6
Horse riding	:	
Digging	:	

Activity	Energy expenditure (BMR Multiple Factor)
Tournament	
Tree cutting	
Jogging	7.8
Running	
Skipping	
Hiking	
Mountain climbing	

Bouchard *et al*, 1983; Satyanarayana *et al*, 1988.

Note: If you spend 1 Kcal/min during sleep (Basal Metabolic Rate, BMR), the above figures need to be adjusted for body weight. If you spend less (for example 0.9), the factor 0.9 has to be multiplied by the figures given for other activities and also corrected for body weight.

AVERT STRESS

Stress eludes definition and is highly individual. Stress may be acute (unexpected events), chronic (bereavements) or intermittent (conflicts). A certain amount of stress is desirable to provide the stimulation and motivation to act.

"STRESS IS A NON-SPECIFIC RESPONSE OF THE BODY TO ANY DEMAND MADE UPON IT"

- Hans Selye

Stress can be physical, social or emotional. Stress causes the heart to beat faster, the blood pressure to go up, the muscles to become tense and the arteries to go into spasms. All these occur through release of a substance called adrenaline. These are termed *flight* or *fight reactions*.

There is an attitude to life which psychologists call *Type A behaviour*. The type A person is ambitious, competitive, work oriented, impatient and is under pressure for time and easily becomes tense and angry. They are more prone to heart diseases. The type B person is easy going, less anxious, contended, philosophical and is less prone to heart diseases. Occupational and family stress increase blood

pressure. Stress often forces one to adopt unhealthy habits like drinking, smoking and over eating. In order to cope with stress, priorities have to be spelt out, so that one can work towards a goal with a clear idea of what one would like to achieve and at what cost.

IT IS NOT WORK BUT WORRY THAT KILLS

PRACTICE YOGA

Yoga, the *age-old Indian practice* of mind and body control, can play a prominent part in all walks of life including health and disease. Yogic practices are ancient in India, systematised by Patanjali around the third century B.C.

The function and state of the mind has its repercussions upon physical well being. Several chronic diseases, including heart and blood vessel diseases where many factors are known to interact, can be expected to be influenced by innumerable signals, some of which can be modified by yogic practice. As Dr. S. Radhakrishnan pointed out: "In it (Yoga) we have all reservoirs of life to draw upon of which we do not dream, it formulates the methods of getting at our deeper functional levels".

There are several schools of Yoga in the country which can be consulted. Choose those practices which suit your life-style.

PRACTICE YOGA FOR BETTER HEALTH

STOP SMOKING

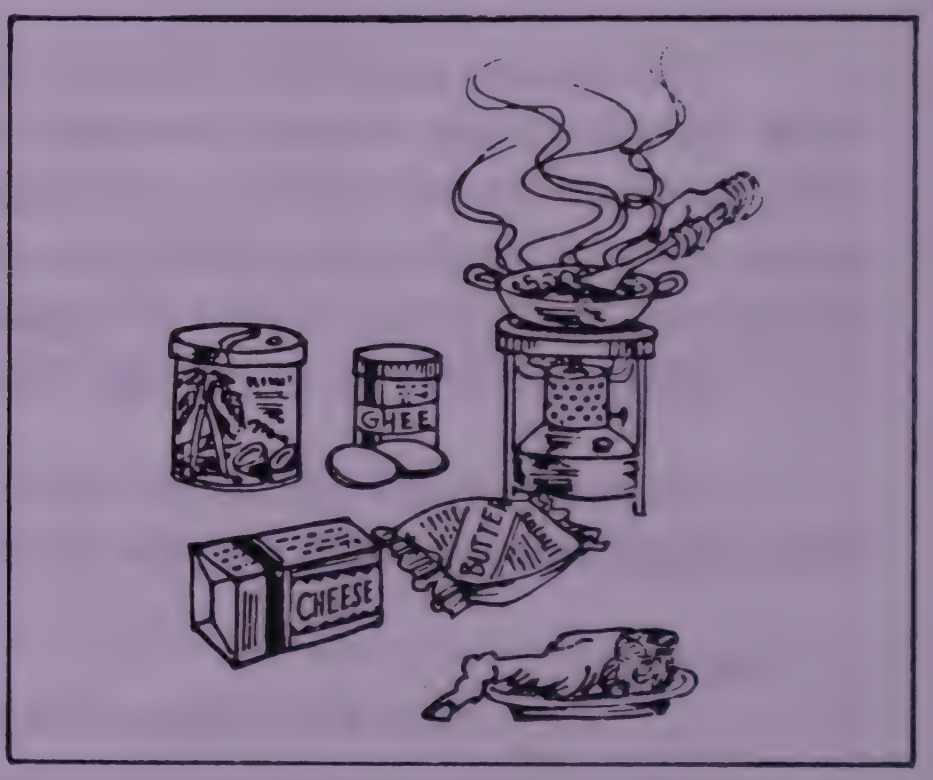
Heart attacks are more common among smokers. The risk increases with the number of cigarettes you smoke as well as the duration of smoking. It decreases if one stops smoking. If even after one attack, the person gives up smoking, the chances of a second attack are reduced.

THINK AND STOP TODAY

10. NATURE'S PRESCRIPTIONS FOR A HEALTHY HEART

EAT TO LIVE, DO NOT LIVE TO EAT.

MAINTAIN A DESIRABLE BODY WEIGHT.



CLEAN UP THE OILY MESS.

REDUCE TOTAL FAT AND SATURATED FAT. AVOID CHOLESTEROL, AND USE VEGETABLE OILS IN MODERATION.

HE WHO FOLLOWS NATURE IS NEVER OUT OF THE WAY.

EAT NATURAL FOODS AS GROWN, LIKE COARSE GRAINS, WHOLE-GRAIN CEREALS AND PULSES, AND VEGETABLES. AVOID REFINED FOODS, PROCESSED FOODS AND SUGAR.

NATURE IS BOUNTIFUL, SO STAY CLOSE TO IT.

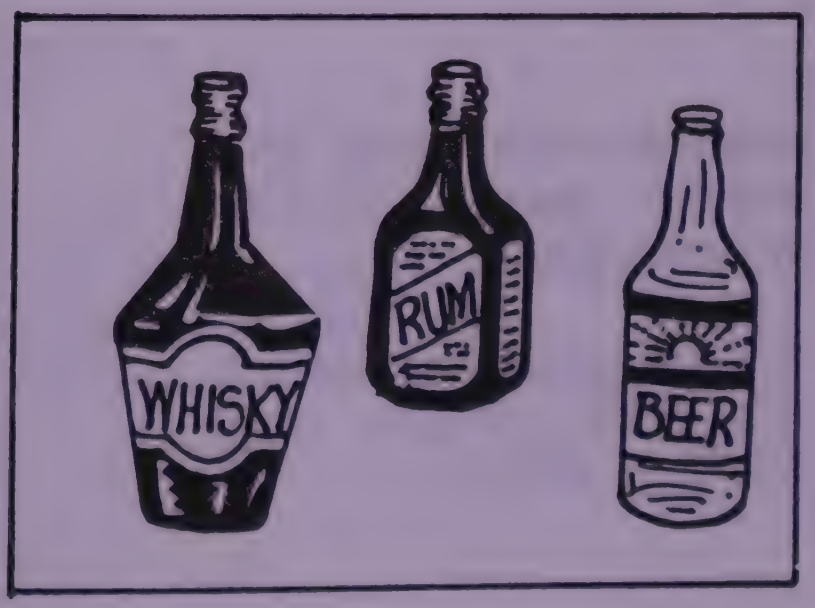
EAT MORE FRESH FRUITS AND VEGETABLES. IF YOU LIKE FISH, EAT 2-3 TIMES A WEEK.

A LITTLE SALT IS DIVINE, BUT TOO MUCH IS HARMFUL.

CUT DOWN SALT USE, EAT FOODS IN NATURAL STATE. KEEP THE SALT INTAKE LOW.

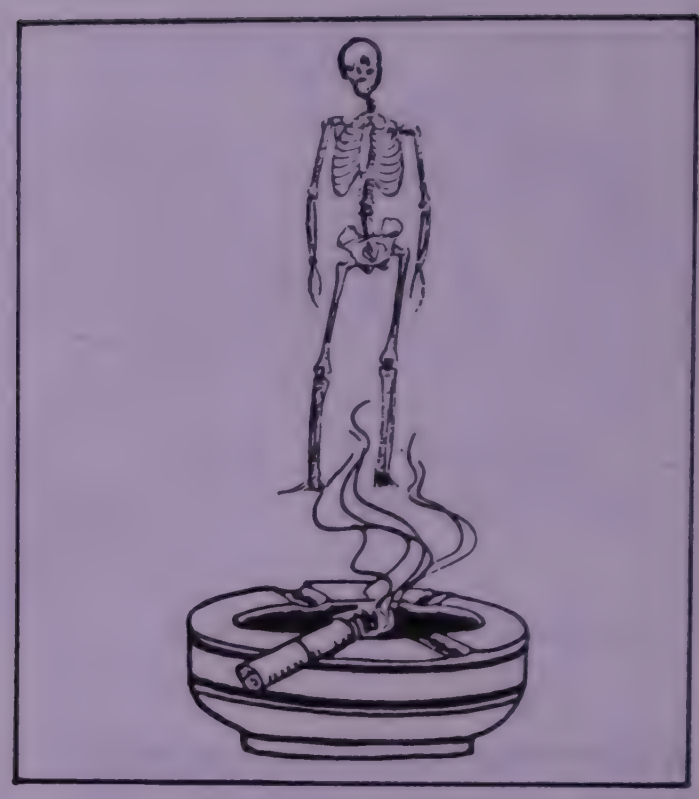
THERE IS A DEVIL IN EVERY BERRY OF THE GRAPE.

AVOID ALCOHOL.



DON'T GET REDUCED TO ASHES.

DON'T SMOKE.



THE WISE DEPEND ON EXERCISE FOR FITNESS.

TAKE TO REGULAR EXERCISE.

HOPE FOR THE BEST AND DON'T DRIVE YOURSELVES TO DEATH.

GET TO KNOW THE SOURCE OF YOUR STRESS. AND AVOID IT. RELAX !

11. NUTRIENT GUIDELINES FOR PREVENTION OF HEART DISEASES

CALORIES SHOULD BE SUFFICIENT TO MAINTAIN APPROPRIATE BODY WEIGHT FOR A GIVEN HEIGHT.

TOTAL FAT INTAKE SHOULD BE BETWEEN 15-30% OF TOTAL CALORIES.

CHOLESTEROL SHOULD NOT EXCEED 300 mg/day IN THE DIET. A CHOLESTEROL FREE DIET IS PREFERABLE.

SATURATED FAT(S) SHOULD BE LESS THAN 10% OF TOTAL CALORIES.

POLYUNSATURATED FAT (P) SHOULD NOT EXCEED 8% OF TOTAL CALORIES.

P/S RATIO SHOULD BE BETWEEN 0.8 - 1.0.

LINOLEIC ACID (LA) SHOULD RANGE BETWEEN 3-7% OF CALORIES.

ALPHA-LINOLENIC ACID (ALNA) SHOULD NOT BE LESS THAN 1% OF CALORIES.

LA/ALNA RATIO SHOULD BE BETWEEN 5-10.

PROTEINS SHOULD PROVIDE AROUND 10-15% OF CALORIES.

CARBOHYDRATES SHOULD CONSTITUTE 55-65% OF CALORIES WITH EMPHASIS ON COMPLEX CARBOHYDRATES.

SUGARS SHOULD BE LESS THAN 10% OF TOTAL CALORIES AND SHOULD BE KEPT TO A MINIMUM.

SALT INTAKE SHOULD BE BETWEEN 5-7 g/day.

DIETARY FIBRE SHOULD BE AROUND 40 g/day.

A WIDE VARIETY OF FOODS "AS GROWN" IN PROPER PROPORTIONS SHOULD BE CONSUMED TO PROVIDE THE NECESSARY CARBOHYDRATES, PROTEINS, FATS, VITAMINS, MINERALS AND FIBRE.

(Guidelines, WHO, 1990)

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12. GUIDE TO A HEALTHY DIET

IN ORDER TO IMPLEMENT NUTRIENT GUIDELINES, DIRECTIONS ARE PROVIDED FOR PROPER FOOD CHOICES IN THE FOLLOWING TABLES.

Table - 17
FOOD GUIDE FOR A HEALTHY HEART

Foods	Prefer	Limit	Avoid
Cereals	wheat, rice, ragi, bajra, maize, jowar	foods prepared with maida like white bread and biscuits	cakes, pastries, naan roti, roomali roti, noodles.
Pulses	whole & sprouted and dhals	---	---
Vegetables	green leafy vegetables and other vegetables	roots and tubers	fried vegetables, banana chips, canned vegetables
Fruits	fresh fruits		dried fruits, canned fruits in syrup.
Dairy products	low fat milk, buttermilk, skimmed milk	whole milk, milk powders.	cheese, butter, khoa, condensed milk, milk cream
Eggs	egg white	---	egg yolk
Animal foods	fish	chicken	prawns, shrimps, all types of meat.
Fat	more than one type of vegetable oil	total fat intake	oily dishes, butter, ghee, coconut oil, vanaspati, deep-fried foods
Sugar & sugar products	sugar, jaggery	sugar in any home-made beverages	sweets like chocolates, icecreams.
Nuts & oilseeds		all nuts & oilseeds	
Beverages	fresh fruit juice (without sugar), light tea	coffee, cola, soft drinks	alcohol
Salt	foods in natural state	too much salt in preparations	pickles, papads, sauces, salt biscuits, fried crispies

Table - 18

APPROXIMATE CALORIES FROM A GRAM OF RAW FOOD

Food Item	Per gram
Cereals	3 kcal
Pulses	3 kcal
Other vegetables	0.6 kcal
High calorie roots & tubers[a]	1.0 kcal
Other roots & tubers	0.3 kcal
Green leafy vegetables	0.4 kcal
Milk	0.9 kcal/ml
Skimmed milk	0.3 kcal/ml
Cream	3.0 kcal
Khoa (from whole milk)	4.0 kcal
Cheese	3.5 kcal
Animal foods	1.0 kcal
Spices	3.0 kcal
Sugar	4.0 kcal
Butter	7.0 kcal
Oils/Ghee/Vanaspati	9.0 kcal
Nuts & Oilseeds	6.0 kcal
Eggs	86 kcal/egg

For low calorie diets, cut down cereals, fats, cream, sugar. Use more vegetables, fruits, pulses, skim milk.

[a] Sweet potato, potato, colocasia, yam.

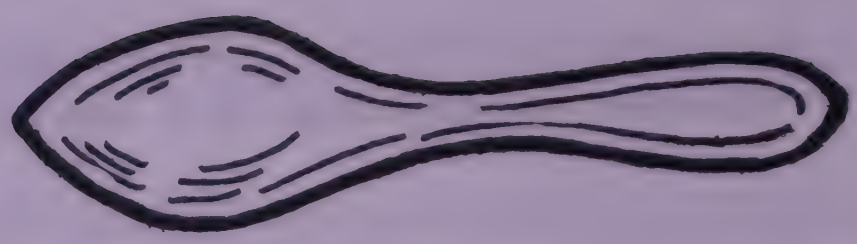
Table - 19

EASY WAY TO COUNT YOUR CALORIES
(Measures providing about 100 K. calories)

Food Item	Quantity (g)	Measure (k = katori)
Cereals	30	1/5 K
Millets	30	1/3 K
Pulses	30	1/4 K
Leafy vegetables	250	12 bundles
Other vegetables	400	4 K
Roots & Tubers	100	1 K
Nuts & Oilseeds	20	
Fruits	140	One fruit
Milk (buffalo)	90	1/3 K
Milk (cow)	150	1 K
Curd (cow)	170	1 1/6 K
Buttermilk (lassi)	670	4 K
Cheese	30	1 pkt.
Ghee	10	2 tsp.
Butter	15	3 tsp.
Egg	60	-
Chicken	90	-
Mutton	85	-
Fish (lean)	100	-
Fish (fatty)	60	-
Shrimps	30	-
Prawns	100	-
Sugar	25	5 tsp.
Vegetable oils and vanaspati	10	2 tsp.
Spices	40	6 tsp.

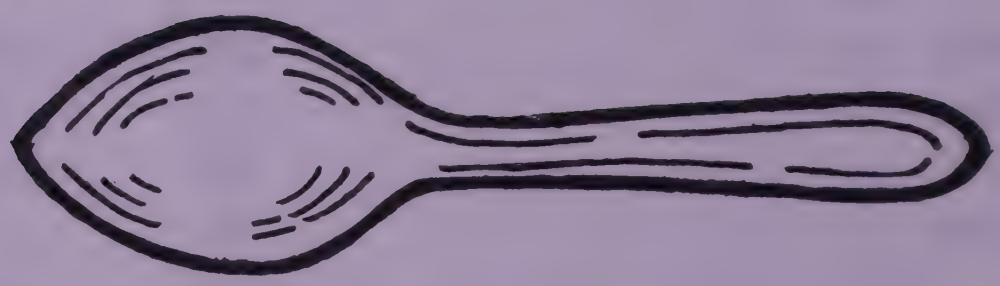
Gopalan *et al*, 1989, Pasricha, 1989.

5 ml

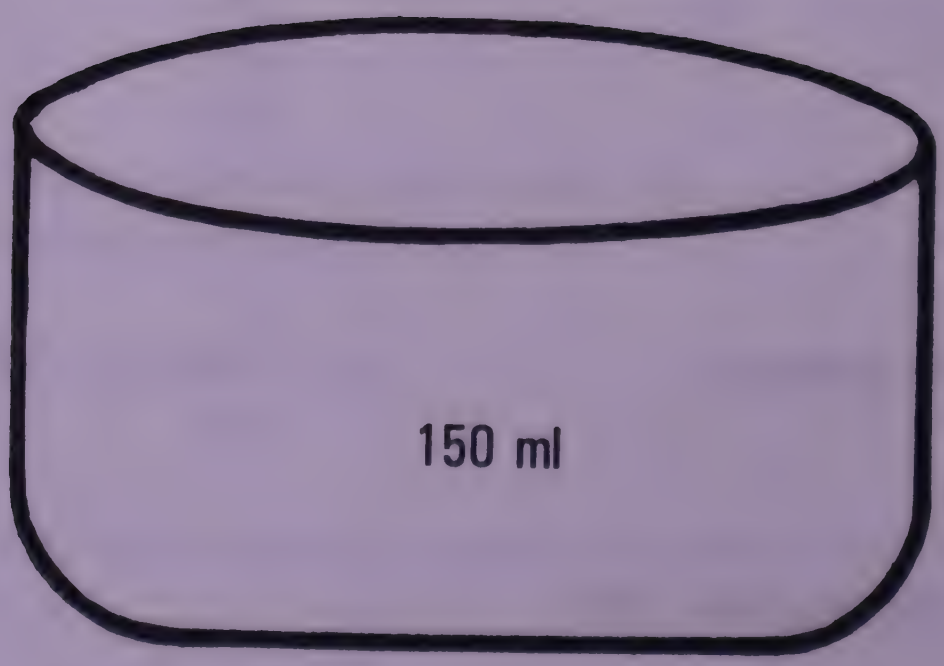


TEASPOON

15 ml



TABLESPOON



KATORI

Table - 20

CALORIES, PROTEIN AND FAT CONTENT OF COMMON FOOD ITEMS (RAW) (HOUSEHOLD MEASURES)

Item	Measure	Weight g.	Energy Kcal.	Protein g.	Fat g.
Cereals					
Rice	1 K	150	520	10	3
Wheat flour	1 K	90	310	11	3
Millet flour	1 K	90	300	11	3
Pulses					
Bengalgram dhal	1 K	130	485	27	9
Other dhals	1 K	135	460	32	3
Whole pulses					
Greengram	1 K	140	470	34	3
Cowpea (lobia)	1 K	135	440	33	4
Rajmah	1 K	120	415	27	3
Soyabean	1 K	130	530	60	27
Green leafy vegetables	5 B	100	62	3.0	0.4
Other vegetables		100	26	2.0	0.2
Roots and tubers		100	105	1.0	1.0
Nuts and Oilseeds					
Almonds	10 No.	15	85	3.0	8
Cashewnuts	10 No.	15	95	3.0	8
Coconut (fresh)	1 No.	115	510	5.0	50
Coconut (dry)	1/2 No.	45	290	3.0	30
Groundnuts	50 No.	15	85	4.0	6
Sesame seeds	1 tsp.	3	15	0.6	1

Item	Measure	Weight g.	Energy Kcal.	Protein g.	Fat g.
Spices					
Chillie powder	1 tsp.	7	17	1.0	1.0
Coriander seeds	1 tsp.	7	20	1.0	1.4
Cumin seeds	1 tsp.	5	18	1.0	0.5
Fenugreek	1 tsp.	6	20	1.6	0.6
Mustard seeds	1 tsp.	10	5	2.0	4.0
Garlic	6 pods	3	4	0.2	0.02
Onion	1 med.	50	30	0.9	0.1
Animal foods					
Milk (Buffalo)	1 K	150 ml.	175	6.0	10
Milk (cow)	1 K	150 ml.	100	5.0	6
Egg (hen)	One	60	100	8.0	8.0
Mutton		100	194	18.0	13.3
Fish (lean)		100	100	18.0	1.5
Fish (fatty)		100	150	90.0	6.0

B : Bundles K : Katori tsp: teaspoon

Gopalan, *et al.,* 1989; Ghafoorunissa, 1989a; Pasricha, 1989.

Table - 21

APPROXIMATE NUTRIENT VALUE OF COMMON COOKED FOODS

Item	No. of serving	Weight of cooked preparation g.	Energy Kcal	Fat g.	Protein g.
I. Cereal preparations					
Rice	1 K	100	110	0.1	2
Idli	1	60	75	0.1	2
Plain dosa	1	40	125	3	3
Masala dosa	1	100	200	6	4
Phulka	1	35	80	0	3
Paratha	1	50	150	4	4
Upma	1 K	130	200	9	5
Sevian upma	1 K	80	130	4	3
Bread toasted	2 slices	50	170	1	4
Poha (Awal)	1 K	100	200	9	2
Dhalia	1 K	140	165	7	5
Kichidi	1 K	100	210	7	4
Puri	1	25	80	3	2
II. Pulse preparations					
Plain dhal	1 K	140	170	4	10
Sambar	1 K	160	81	2	4
Chole/Sundal	1 K	150	115	5	7
III. Vegetable preparations					
With gravy	1 K	130	130	7	3
Dry	1 K	100	115	7	2
Bagara Baigan	1 K	170	230	20	3
Vegetable kofta	1 K	145	220	14	4
IV. Fried snacks					
Bhajji	1	7	35	3	0.5
Samosa	1	65	210	12	2
Kachori	1	45	200	12	3
Potato Bonda	1	40	100	5	3
Sago vada	1	30	100	6	1

Item	No. of serving	Weight of cooked preparation g.	Energy Kcal	Fat g.	Protein g.
IV. Fried snacks (contd.)					
Masala vada	1	20	56	2	2
Vada	1	20	65	3	3
Dahi vada	1	80	170	9	5
Vegetable cutlet	1	30	70	5	1
V. Chutneys					
Coconut/ground nuts/til/coriander	1 tbsp	25	64	5	3
Tomato	1 tbsp	20	10	0.3	0.3
VI. Non-Vegetarian preparations					
Boiled egg	1	50	86	7.0	7.0
Omlette	1	65	155	14.0	7.0
Fried egg	1	50	155	14.0	7.0
Mutton curry	1 K	145	240	18	10
Chicken curry	1 K	125	260	15	26
Fish (fried)	2 pieces	85	220	12	18
VII. Bakery products					
Biscuits	2	40	220	14	3
Cake	1	40	220	13	3
Vegetable puff	1	60	170	10	3
VIII. Sweets					
Laddu, burfi etc.	1	60	250	15	8
Halwa (Suji)	1 K	130	430	20	3
Double ka meetha	1 K	105	280	18	4
Custard/puddings	1 K	110	180	6	5
Chikki	2	60	300	12	8
Jam/Jelly	1 tsp.	7	20	0.04	0.04

K = Katori, tbsp = tablespoon, tsp = teaspoon.
Calories and fat will depend on sugar and oil/ghee added.
Pasricha, 1989.

Table - 22
SALADS AND CALORIES

Item	No. (Medium size)	Weight g.	K.cals.
Beetroot	1	65	30
Cabbage	1	250	70
Carrot	1	40	20
Cucumber	1	90	12
Lettuce	6 bundles	100	20
Onion	1	50	25
Radish	1	60	10
Tomato	1	50	10
Turnip	1	100	30

Note : You can exchange salads freely for any other item of the food to fill your stomach and lower your calorie intake.
Approximately 300-400 g. of a salad combination carries 100 calories.
Wash vegetables thoroughly and use either raw or after a short exposure to steam in pressure cooker.

Table - 23
FRUITS AND CALORIES

Item	No./Quantity	Weight (g.)	K.cals.
Apple	1	100	65
Banana	1	80	90
Grapes	30	100	70
Guava	1	100	50
Jack fruit	4 pieces	100	90
Mango	1	250	180
Mosambi/orange	1	100	40
Papaya	1 piece	250	80
Pineapple	1 piece	100	50
Sapota	1	80	80
Custard apple	1	130	130
Watermelon/Muskmelon	1 piece	100	15

One banana is equal in terms of calories to two apples or two guavas or two mosambis or 8 pieces of watermelon.
A mango is equal in terms of calories to 3 apples.

Table - 24

BEVERAGES AND CALORIES

Item	Measure	Quantity (ml)	K.cals.
Coffee	1 cup	150	100
Tea	1 cup	50	60
Carbonated beverages	1 bottle	200	150
Fresh lime juice	1 glass	200	60
Squash	1 glass	200	80
Syrups (sherbat)	1 glass	200	200

Table - 25

DIET PROVIDING 1000 Kcals WITH FOODS WHICH ARE KNOWN TO BE PROTECTIVE FOR HEART DISEASE

Foods	Vegetarian g.	Non-vegetarian g.	Nutrients		
Cereals	140	140	Protein	38	g.
Pulses	40	30	Carbo-hydrates	156	g.
Green leafy vegetables	100	100	Fat	22	g.
Other vegetables	150	150	Saturated fatty acids	4	g.
Roots and tubers	100	100	Fibre	35	g.
Fruits	100	100	Linoleic acid	7	g.
Milk (low fat)	200	200	Alpha-linolenic acid	1	g.
Oil	15	15	Carotene	4000	ug.
Flesh foods	--	50	Cholesterol	<50	mg.
Fish	--	100 (fatty) or 200 (lean)	Calcium	800	mg.
			Riboflavin	0.9	mg.
Egg (white only)		1	Thiamin	0.9	mg.
			Vitamin C	135	mg.

- Flesh foods (mutton/chicken) not more than once a week.
- Fish : 2-3 times/week.
- Egg yolk to be avoided, but egg white can be taken.
- Condiments and spices to suit your taste.
- Daily usage of the following offers an additional advantage;
  Garlic 0.5 g, methi seeds 5 g. (one tsp), methi can be included in various preparations to one's taste and choice (phulkas, idlis, sambar, dosa, etc.)

Table - 26

SAMPLE MENU FOR 1000 Kcals DIET : VEGETARIAN

Early Morning	Tea/Coffee	One cup	
Breakfast	Phulkas	Two	
	Dhal curry	3 tbsp	300 Kcals
	Tea/Coffee	One cup	
Mid morning	Any fruit	One	
Lunch	Rice	1 Katori	
	Dhal with any green Leafy vegetable	1 Katori	
	Rasam or Vegetable soup	1 Katori	400 Kcals
	Buttermilk	1 Katori	
	Salad of tomato Onion, carrot	1 each	
Snack	Upma	1 Katori	
Tea	Tea/Coffee	1 cup	
Dinner	Rice	1 Katori	
	Any vegetable curry	1 Katori	
	Rasam	1 Katori	
	Buttermilk	1 Katori	300 Kcals
	Salad of carrot, radish cucumber	1 each	
Bedtime	Any fruit	One	

* A multivitamin pill with B-complex and several minerals, containing about 5 times the recommended dietary allowances (Tables 6a and 6b) should be taken once in a day on reducing diets.
* Tea/Coffee to be taken without sugar.
* Cooking oil not to exceed 15 g.

Breakfast Exchanges

Paratha with	...	One
Potato curry	...	1/2 Katori
Puri	...	Two
Potato curry	...	1/2 Katori
Idli	...	Two
Coconut chutney	...	1 tbsp
or Sambar	...	3/4 Katori
Vada	...	Two
Sambar	...	1 Katori
Dosa	...	Two
Coconut chutney	...	1 tbsp

Snack Exchanges

Poha	...	1/2 Katori
Bhajji	...	3
Masala vada	...	2
Potato Bonda	...	1
Sago vada	...	1
Sandwich	...	1
Savian upma	...	3/4 K
Puffed rice	...	1/2 K
Salt biscuits	...	2 Nos.
Sweet biscuits	...	2 Nos.
Plain cake (50 g.)	...	3/4
Chole	...	3/4 K
Sundal	...	3/4 K

Lunch Exchanges

Rice		Dhal	
Pulao	3/4 K	Raita with onions	1/2 K
Kichidi	1/2 K	Sambar	1 K
Lime rice	3/4 K	Green vegetable kootu	3/4 K
Tamarind rice	3/4 K	Kadi	3/4 K

Dinner Exchanges

Rice - 1 Katori or Phulka - 2	Vegetable		Rasam	
	Peas + Panir	1/2 K	Tamarind rasam	1 K
	Potato curry	1/2 K	Carrot soup	1/2 K
	Vegetable kofta curry	1/2 K	Tomato soup	1/2 K
	Vegetable kurma	3/4 K	Mixed vegetable	
	Beans curry	1 K	soup	1/2 K
	Capsicum curry	3/4 K		
	Cauliflower &			
	Carrot curry	1 K		
	Kovai curry	1-1/4 K		
	Lady's finger curry	3/4 K		
	Ridge gourd curry	1 K		
	Stuffed tomato	1 No.		
	Dam-ka-chicken	1/2 K		
	Fish cutlet	1		
	Fish fry	1 big piece		
	Prawns curry	1/2 K		
	Mutton curry	1/2 K		

K = Katori.

For recipes, refer Pasricha, 1989.

The exchanges ensure selection of a wide variety of food items and permits one to eat the same foods as the rest of the family members.

Remember that the visible fat employed should not exceed 15 g/1000 Kcals.

The exchanges given above are equivalent to sample menu items only in terms of calories.

PLANNING YOUR DIET

Objectives

To reduce body weight and to control blood cholesterol and blood glucose without losing the protective nutrients.

Steps

1. Consult your doctor or dietitian to fix the desirable calorie intake.

2. Draw up a list of all the food items you consume in a typical day.

3. Use Table 21 to assess whether your current intake of total calories, fat and protein falls within the recommended range.

4. If your present intake of total calories, fat, protein and fibre falls within the range recommended for YOU and if you are also consuming fresh fruits and vegetables daily, CONGRATULATIONS ! You are taking a balanced diet and there is no need to change your dietary habits.

5. If, however, your present intake differs from the recommendations, adjust your diet accordingly.

6. For example, if you are advised 1000 Kcals (Table 25) look up the tables giving food quantities and calories (Tables 18 to 20).

7. Keep your protein intake at 35 g. (15% of total calories).

8. Keep your fat intake (visible + invisible) around 20 g. (20% of total calories).

9. Remember that you are getting about 8 g. of invisible fat from food items, such as cereals, pulses, milk, meat, etc. (Table 7). Therefore, the rest can be visible fat. Avoid saturated fat and cholesterol (Tables 8 and 9).

10. Use any vegetable oil except coconut and vanaspati along with mustard oil (Table 8).

11. Choose n-3 PUFA, fibre and antioxidant rich foods (Tables 10-12). You will then get everything you need.

13. SIMPLE MESSAGES

TIPS FOR GOOD EATING

Make breakfast the largest and dinner the lightest meal of the day.

Be a nibbler, not a gourmet.

Eat your salad before you eat the meal.

Don't starve yourself and overeat subsequently.

Before cooking, remove all fat from meats and also skin from chicken.

Avoid purchasing minced meat, the butcher finds it more profitable to sell this without removing fat surrounding the flesh portion.

Do not sieve wheat and millet flours as it reduces the nutrients and fibre.

Repeated heating of oils should be avoided.

Use a scrubber and not a peeler for removing the skin from vegetables.

Avoid deep frying and prefer steamed foods.

Use non-stick pans and vessels to cut down the use of cooking oil.

Fast foods and canned foods are costly, both for your pocket and your heart.

Don't overuse salt.

Dine at least two hours before you go to bed.

Yellow, orange and green vegetables and fruits add life to your heart.

Remember that heat, light and air are enemies of anti-oxidant vitamins. Don't cut vegetables and expose them to light for long periods. Pressure cook the vegetables.

As age advances, eat less, exercise more.

EATING ON TIME, A VARIETY OF NATURAL PLANT FOODS WITH LOW FAT MILK AND LESS SALT, IN QUANTITIES TO MAINTAIN IDEAL WEIGHT IS THE KEY TO A HEALTHY LONG LIFE

FALLACIES AND FACTS

	Fallacies		Facts
1.	A zero fat diet is excellent.	No	Some amount of fat is necessary.
2.	Cholesterol containing foods are the only culprits.	No	Saturated fats also increase blood cholesterol. The two together have additive effects.
3.	Only oils need to be cut down.	No	A total change to a healthy dietary lifestyle is also necessary.
4.	Plenty of vegetable oils are good.	No	Moderation in their use must be exercised.
5.	Safflower and sunflower oils can be taken as much as you want.	No	Excess of these oils can decrease "good" cholesterol.
6.	Vegetable oils do not have cholesterol.	Yes	But vegetable oils consumed in excess can cause an increase in total fat intake. Too much of fat in the diet increases blood cholesterol.
7.	Starvation and rapid decrease in body weight are good.	No	Body weight reduction should be gradual, starvation is not the solution.
8.	One meal a day is good for body weight reduction.	No	Frequent and small meals are far better.
9.	Alcohol is good for the heart.	No	Alcohol does not increase "good" cholesterol.
10.	Only plain sugars increase blood sugar levels.	No	All carbohydrates can increase blood sugar. Refined foods and sugar increase blood glucose rapidly.
11.	Only fat people need to worry.	No	Even individuals who are normal in weight can have higher body fat and blood lipids.
12.	Only vigorous exercises are good.	No	Even a long brisk walk will help very much.

POINTS TO PONDER

1. A cup of tea with 2 tsp sugar 5 times a day provides you the maximum permissible sugar.

2. A medium-sized sweet item of any type gives calories equivalent to 50 g. raw rice.

3. 3 cups of milk give 10 g. of saturated fat, 1/3rd the suggested upper limit of saturated fat for diets providing 2400 Kcals.

4. About 2 tsp of butter or ghee per day gives about 1/4th the suggested upper limit of saturated fat for diets providing 2400 Kcals.

5. A regular consumption of legumes/dhals (particularly blackgram /rajmah/lobia) and green leafy vegetables, fenugreek and mustard seeds adds to the quality of fat in Indian diets.

6. Fish improves the quality of fat.

7. One egg provides 210 mg. of cholesterol.

8. 1 tsp of pickle gives about 1.5 g. of salt and about 2 g. of fat, 1 papad gives about 0.5 g. of salt.

9. Though nuts such as almonds, cashewnuts and walnuts have high levels of monounsaturated fatty acids which are not harmful like saturated fatty acids, these nuts have to be limited/avoided because of their high fat content. 5 almonds gives about 1 tsp fat.

14. SYMPTOMS

HOW DO YOU RECOGNISE A HEART ATTACK ?

Men are more prone to heart attacks. The frequency of heart attacks is more common among men between the ages of 30 and 40. It is less known in women of the same age groups, though after the age of 40, women are also equally susceptible as men.

WARNING SIGNALS

Heart Attack

* Sudden, severe, burning pain in the centre of the chest which may subside after rest and is exaggerated by exertion.
* A feeling of strangulation or uncomfortable pressure, squeezing or pain lasting for two minutes or longer.
* Unusual discomfort in the centre of the chest radiating to the neck, back, left shoulder and down the left arm.
* Abnormal perspiration.
* Nausea, vomiting.
* Momentary loss of consciousness.
* Palpitations and irregularities in heart beat.

All such attacks are brief and may disappear on resting but they should not be ignored.

Blood Pressure

* Blood pressure need not produce any symptoms but some may have
* Persistent headache.
* Headache in the morning.
* Headache localised in the back of the head.

Stroke/Peripheral Vascular Disease

* Changing patterns of headache or persistent headache
* Numbness in limbs
* Fainting spells
* Momentary lapses in memory
* Slurred speech
* Sudden drowsiness
* Weakness in limbs and loss of balance
* Visual disturbances like dimness or loss of vision
* Personality changes
* Severe pain and cramps in the legs on walking

YOUR BODY MAY BE SENDING OUT WARNING SIGNALS
CONSULT YOUR DOCTOR IMMEDIATELY

Regular check-ups even in the absence of symptoms are essential for prevention particularly if you have a family history.

Check up for blood pressure, blood sugar, cholesterol and triglycerides once in 5 years between 25-35 years of age and once in a year after 35.

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Glossary of Terms

A. Clinical

1. **Aneurism** : A sac or balloon like swelling formed by the dilatation of the wall of an artery.

2. **Atherosclerosis** (athero: gruel or paste; sclerosis: hardness) : The process which leads to build-up of fatty materials and fibrous tissues in the inner lining of the arteries with eventual obstruction of blood flow.

3. **Body Mass Index** : Body weight in relation to height. Body weight (kilograms) divided by height^2 (metres).

4. **Blood clot** : A semi-solid mass consisting of a mesh of a protein, in which various blood cells are trapped.

5. **Chronic** : Disease persistent over a long period of time involving very slow changes.

6. **Diabetes mellitus** : A disease in which the blood glucose is increased and the body tissues do not use glucose properly.

7. **Gangrene** : Death of a tissue due to cessation of blood supply followed by infection and decay.

8. **Genetic diseases** : Diseases which are due to defects in the genetic material.

9. **Haemorrhage or bleeding** : The escape of blood from a ruptured blood vessel.

10. **Ischemia** : Lack of blood supply to an organ or tissue resulting in reduced oxygen supply, caused either by constriction or obstruction of the blood vessel.

11. **Paralysis** : Muscle weakness that varies in extent and severity, resulting in loss of movements and sensation in any part of the body. It involves either the muscle or the nerve (brain).

12. **Risk factors** : Characteristics or conditions whose presence is associated with the future chance of developing a disease. The relationship is one of probability.

13. **Stroke** : Popular term for cerebro-vascular disease, a sudden condition that results from blocking or bleeding of blood vessels in the brain, resulting in paralysis.

14. **Thrombosis** : The condition in which the blood changes from a liquid to a semi-solid state and produces a blood clot (thrombus) which blocks blood flow.

B. Biochemical

1. **Antioxidants** : A group of substances that prevent the damage which could be caused by the oxidation of fatty acids and proteins by free radicals.

2. **Arachidonic acid** : A fatty acid of the n-6 series with 20 carbon atoms and containing four double bonds; is synthesized in the body from linoleic acid.

3. **Calorie** : Unit used to indicate the energy value of foods. Quantitative food requirements are estimated in terms of energy, i.e., kilocalories (K.cals).

4. **Carbohydrates** : These are one of the major dietary constituents composed of carbon, hydrogen and oxygen with two atoms of hydrogen for every oxygen. Excess of dietary carbohydrate is converted into fat in the body.

5. **Cis fatty acids** : Monounsaturated fatty acids commonly found in natural foods in which the hydrogen atoms attached to the two carbons of the double bond exist on the same side of the plane containing the double bond.

6. **Cholesterol** : Principal steroid present in all body tissues of higher animals. A major part of the cholesterol present in the human blood and tissues is sysnthesized in the body, and the rest comes from the diet.

7. **Essential fatty acids (EFA)** : Fatty acids which are not made in the human body and must be supplied through the diet. They are linoleic acid and alpha linolenic acid.

   Linoleic acid : Fatty acid containing 18 carbon atoms (chain length) and two double bonds. The first double bond is on the sixth carbon atom from the methyl (CH_3) end and therefore it is called n-6 fatty acid. It is abbreviated as 18: 2 n-6.

   Alpha-linolenic acid : 18 carbon fatty acid with three double bonds, first double bond is on third carbon atom from the methyl end and therefore it is called n-3 fatty acid. It is abbreviated as 18: 3 n-3.

8. **Fats and oils** : Common terms used to refer to extracted lipids. When solid at room temperature they are called fats and when liquid, as oils.

9. **Fatty acids** : Fundamental constitutents of many lipids. They are organic acids with a hydrocarbon chain and an even number of carbon atoms. They have repeating CH_2 units with a methyl group (CH_3) at one end and a carboxyl (COOH) at the other end. Fatty acids are generally classified as saturated and unsaturated.

   Saturated fatty acids : Contain maximum number of hydrogen atoms that each carbon atom can carry. They do not have double bonds.

   Unsaturated fatty acids : Fatty acids in which there is a shortage of hydrogen atoms. The carbon atoms then become linked by double bonds.

Double bonds are susceptible to the addition of oxygen (peroxidation) and hence unsaturated fatty acids are less stable than saturated fatty acids.

Monounsaturated fatty acids : Unsaturated fatty acids with one double bond.

Polyunsaturated fatty acids : Unsaturated fatty acids with two or more double bonds.

10. **Fibrinogen** : A protein present in blood plasma involved in blood clotting. It gets converted to insoluble protein (fibrin) in the final stage of blood coagulation.

11. **Fibrinolysis** : The process by which blood clot is dissolved.

12. **Free radicals** : Highly reactive oxygen derived species formed in the body during normal metabolic processes. They have the capacity to damage cellular components by oxidation.

13. **Hyperlipidemia** : An increase in blood lipids (triglycerides and cholesterol).

14. **Lipids** : A technical term for fats. These are a group of compounds that are soluble in organic solvents but insoluble in water. They are important dietary constituents. The group includes triglycerides, steroids (cholesterol and cholesteryl esters), phospholipids, glycolipids and other complex lipids.

15. **Lipoproteins** : Lipids are not soluble in blood. They are therefore transported as lipid and protein complexes. There are four types of lipoproteins as given below :

Chylomicrons : carry the ingested fats into the blood. They are present in the blood only after a meal and absent in a fasting state.

Very low density lipoproteins (VLDL) : Carriers of triglycerides and cholesterol that are synthesized in the body. VLDL levels in circulation largely reflect lipid synthesis in the body.

Low density lipoproteins (LDL) : These transport cholesterol from the liver to tissues. High blood levels indicate that more cholesterol is being transported to tissues.

High density lipoproteins (HDL) : These transport cholesterol from the extra-hepatic tissues to liver. They are scavengers of cholesterol and therefore anti-atherogenic.

16. **Metabolism** : Includes catabolism and anabolism.

Catabolism : This results in the breakdown of complex organic constituents of the body with the liberation of energy which is required for several processes in the body.

Anabolism : This results in the building up of complex materials in tissues and organs from simple substances.

17. **n-6 PUFA** : Linoleic acid is metabolized in the human body to fatty acids with longer chain length (20 and 22 carbon atoms) having 3.4 or 5 double bonds. Linoleic acid and its longer chain PUFA are collectively called n-6 PUFA.

18. **n-3 PUFA** : Alpha-linolenic acid is metabolized in the human body to fatty acids with 20 carbon chain length containing five double bonds (eicosapentaenoic acid) and 22 carbon and six double bonds (docosahexaenoic acid). Alpha-linolenic acid and its longer-chain PUFA are collectively called n-3 PUFA.

19. **Proteins** : Proteins are made up of amino-acids. Amino acids are composed of carbon, hydrogen, oxygen, nitrogen, sulphur and sometimes phosphorus. Proteins are made up of one or more chains of amino acids linked by peptide bonds. The tissues, enzymes, hormones and other regulators of various processes in the body are all proteins. Excess of dietary protein gets converted into fat.

20. **Triglycerides** (Neutral fat) : Compounds made up of the triesters of fatty acids with glycerol. It is the major type of dietary fat and is the principal form in which energy is stored in the body.

21. **Trans Fatty acids** : Mainly produced during hydrogenation of oils, a few occur naturally. Monounsaturated fatty acids in which the hydrogen atoms assume position on opposite sides of the plane containing the double bond.